Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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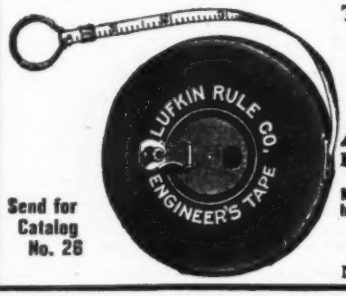

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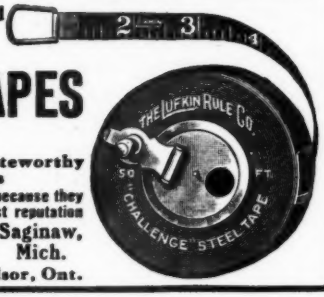

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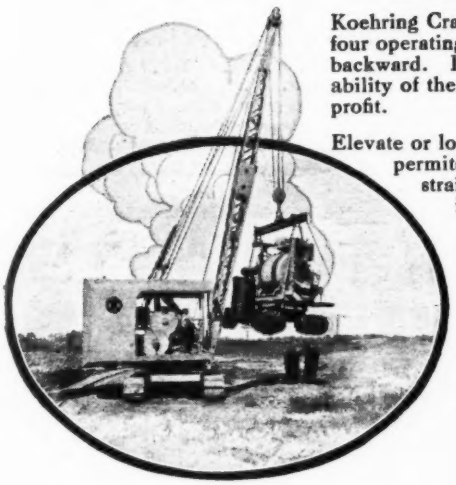

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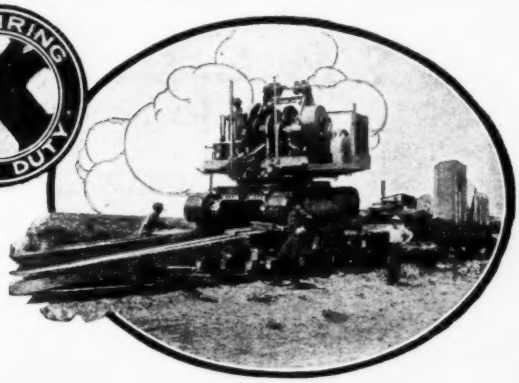

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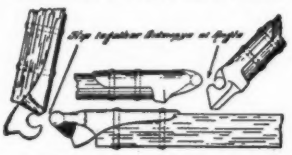

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EDITORIALS

A POPULAR FORM OF ROAD TAXATION.

A popular tax is an unheard of thing, yet the gasoline tax for highway improvement purposes arouses so little opposition, where it is properly formulated and administered and well understood, that it may fairly be called popular. A gasoline tax, or more properly a gasoline fee law, went into effect in Indiana on June 1 and, generally speaking, is being very cheerfully paid by the motor vehicle owners of this state. The tax is for road improvement purposes only; gasoline used in industry and agriculture and for all purposes other than the propulsion of motor vehicles over the highways is exempted from the tax. This makes the tax merely a fee for the use of the public roads. The fee is two cents per gallon. All the proceeds will go to the State Highway Department for use on the state roads except a half million dollars the first year and a million dollars each succeeding year, which will be returned to the counties for use in county highway improvements.

The law is being contested in one county, but there is little doubt it will be held valid in the courts. Outside that one county there is no opposition to the tax. Motorists generally say they don't mind paying the tax as long as the money goes for better roads. They regard it as an investment which will pay big dividends, as the highway system develops, in the form of reduced operating and vehicle upkeep costs.

Now that the tax is in successful operation it is interesting to recall the mighty wave of opposition which its opponents succeeded in stirring up when the measure was pending in the legislature. One then gained the impression that if the bill became a law many would leave the state, while others would remain to wage a revolution. It was loudly asserted that the cost of collection would run into the hundreds of thousands of dollars and that a small army of state employes would be required to collect the tax. That was the prophecy. The fact is, as stated, the tax is as near popular as a tax ever was or ever can be, and the annual cost of collection will not exceed $5,000. Not over two people will be required to collect it and they probably can find time for additional work. This is due largely to the splendid co-operation of the gasoline wholesalers, led by the Standard Oil Company. "Much Ado About Nothing" would be an appropriate name for the comedy staged in the vain effort to prevent this measure from becoming a law. That is, it is comparatively nothing to the individual motorist. It will cost him less than one dollar a month on the average. The gross income from the tax will exceed $3,000,000 per year.

Over half the states now have a gasoline tax. Others have considered it. In Michigan, where the gas tax was defeated, rather a sorry mess has been made of highway financing for the present.

The principle underlying the combined registration fee and gasoline tax is sound and is simply the "readiness to serve" charge plus the metered service charge, proved sound and equitable after generations of experience in water, electric light and illuminating gas rate-making. The license, or registration fee, is the "readiness to serve" charge; the roads are ready to serve when wanted and the vehicle owner is required to pay this basic, or minimum, charge. Additional payment is directly proportional to the use of the road, as the consumption of gasoline not only measures the travel of a vehicle, but to a large degree measures its destructive action on the road surface as well.

This form of taxation for road improvement purposes deserves to be, and probably soon will be, universal. It is growing in favor throughout the world.

EXTENT OF THE HIGHWAY BRIDGE PROBLEM.

The nature and extent of the highway bridge problem is well illustrated by conditions existing in the state of Indiana on the state highway system. On

the present state highway system, which is 4,500 miles in length, fully 10,000 bridges and culverts require either reconstruction or replacement to care properly for present and prospective traffic needs. Probably half of these structures will accommodate but a single line of modern traffic; some are too narrow and others too weak to carry two lines of traffic. The marking of such bridges so as to warn the public as to their safe use is a big job in itself. Many of these bridges are old and most of them were built when public roads were 9, 10 and 12 ft. wide with bridges 14 ft. wide. Few of the older bridges were designed to care for more than a 5 ton load, while today loads range from 8 to 15 tons and occasionally reach 20 tons.

It is, of course, both a physical and financial impossibility to complete such a bridge building program quickly. Such a program must extend over a period of 15 or even 20 years on the state highway system. Even more time will be required to modernize bridges on other roads. Probably this condition is typical of those to be found in all the principal states. The public must be taught patience in connection with this stupendous problem, if we are to avoid the sort of dissatisfaction and criticism which will hamper the work of the highway departments, and must be taught to approach bridges with care as many are unsafe for fast or heavy traffic. Many accidents due to narrow bridges and to those of limited capacity will be avoided when the public learns to cross bridges cautiously.

Rebuilding the highway bridges of this country is not a summer's job, but will require the best working years of many men's lives. Our highway bridge builders are doing a splendid job, building for future as well as present needs.

SUPPOSE THEY ALL QUIT?

Not long ago salary increases were sought by, and on behalf of, certain employes of the city of Indianapolis, including a number of engineers. Department heads made honest efforts to secure reasonable salary increases for their deserving subordinates. The effort was worth while, for some increases were granted; many of these were purely nominal, amounting to a hundred dollars a year or less, and all were far short of the recommended amounts. The City Council merely took cognizance of the requests and sought to satisfy them by minimum concessions. All this was quite ordinary.

An unusual commentary on this effort of municipal employes to make an adequate and honest living was supplied in an editorial in a local newspaper. After lengthy comment having to do with "the taxpayers' money" the editorial concluded with the observation that in practically all cases the municipal employes knew what their pay would be before they accepted their jobs and if they didn't like the pay they could quit.

Of course they could quit and we often wonder why they don't. What if they did? The majority of municipal employes could easily be replaced, but this does not include engineers. So far as the engineers are concerned we do not hesitate to say that practically all of them, at least the subordinates, would better themselves greatly and quickly if they left the municipal service forthwith. But what of the public? The public would suffer and bnowing this the engineer "sticks" because of his sense of public duty. It is becoming a serious question, however, whether he has any right to continue his thankless sacrifices when practically all classes of society who have brains enough to look after their own interests take mighty good care of number one.

Engineers in public service are not going to improve their fortunes very much by such minor increases as they are able to secure from time to time as individuals. These tiny increases are grudgingly bestowed and are likely to be withdrawn at any time. Sometimes increases lead to later reductions which are greater than the increases were, so that the second condition of the engineer is worse than the first. No, these efforts are unavailing.

Either the engineer in public service must regard his position as a stepping stone, as a means to a more profitable end, or as an opportunity, for one of independent means, to render unselfish public service, or he must show the public the value of his services and demand compensation worthy of his skill, making clear, meanwhile, his determination to abandon the public service in due course if his efforts are not properly rewarded. So far as the public is concerned it will never appreciate the public service engineer until it knows the worth of his services and is made to fear the loss of them.

Speaking of newspapers, as we were a moment ago, it is interesting to observe that the only economy the newspaper preaches is economy in public expenditures. It is seldom, indeed, that a newspaper preaches economy in private expenditures. If the newspaper urged it readers to buy a cheaper car, or to make the old car to another year, or to buy inexpensive clothing and house furnishings, to get along without a piano or a phonograph, to cut out the vacation trip, and, above all, to abandon the mad orgy of senseless spending at the Christmas season it would cause its readers to save such great sums of money that taxes would appear insignificant in comparison. But it doesn't do these things as the advertiser who supports it would never stand for the preaching of true economy in private purchases. Therefore the paper rants at public expenditures, appealing to the miserly instinct of the individual in respect to the tax dollar while tempting him to spend his dollar in a thousand other ways from which he may derive less benefit.

Among the most conspicuous sufferers from this indefensible practice are the expensively-educated, public-money-saving engineers. How much longer are they going to stand for it?

PRESENT ASSESSMENT OF A FUTURE BENEFIT

By W. G. Kirchoffer, Sanitary and Hydraulic Engineer, 22 N. Carrol St., Madison, Wisconsin.

Two very interesting problems have been presented to me recently in the matter of making an assessment for a benefit that will not accrue to the assessed until some future time. The first one to come to my attention was the problem of arriving at the amount of the benefits which would accrue to a village by constructing a drainage ditch at the site of the sewage disposal plant.

A few years ago the village of Sun Prairie, Wis., constructed a sewerage system which included an Imhoff tank so located that the effluent was discharged into a very shallow ditch in a marsh adjacent to the plant. The natural flow of water in the drainage ditch was very small, possibly three times the flow of sewage which was about 90,000-gals. per day, based on the water consumption.

The effluent from the plant polluted the waters of the ditch considerably but not enough to cause much protest so that this is not a direct factor in the immediate construction of the new ditch. This proposed ditch is to be constructed under the Wisconsin Farm Drainage Law and is under the jurisdiction of the county commissioners.

The principal purpose of the district is for benefits to agricultural lands. By the construction of this ditch at a depth of 9 ft. it would not only cause a larger flow of ground water in the ditch, but it would make it possible for the village to construct filters that could be operated by gravity. Such construction would avoid the necessity of a sewage pumping station and would save the annual cost of operation which is estimated to be at least $250 per year when the flow has increased to 144,000 gals. per day. This low cost is due to the low power rate for electric current to the small quantity pumped and the low lift.

There is no immediate demand for the further purification of the sewage which might cause the expense of constructing a filter together with a pumping plant. However, it is certain that within 10 to 20 years either the State or Federal Government will require the purification of all sewage to such a stability that it will not cause a nuisance or be detrimental to health. If we were to assume that the annual interest on the investment in a pumping plant was $300 and the annual cost of pumping was $250 and these amounts capitalized at 5 per cent, the amount that the village could afford to spend to avoid the construction and operation of a pumping plant would be $11,000.

To assess this amount to the village for a benefit that will accrue at some future date is obviously unjust. Neither is it fair to the district paying for the improvement, to give this relatively large benefit to the village simply because they don't need it now.

Some assumption must be made as to the time when the village would have to purify its sewage further and what effect the construction of the ditch would have in further putting off that time. It would be extremely fair to the village to assume that these two periods would each be 10 years or a total of 20 years.

For every dollar that the village might lay aside now would at 5 per cent compound interest be worth $2.65 at the end of 20 years. If this benefit is worth $11,000 to the village in 20 years it is now worth that sum divided by $2.65, or $4,-

150. This sum should then be the basis of benefits assessed to the village. The actual cost of construction being about 35 per cent of the benefits the actual cost to the village would be $1,452.50.

The other problem was a similar one but less difficult. Under the Wisconsin Law Chapter 62.18 a city or village can pay for the cost of a sewerage system by the city at large by the front foot or by sewerage districts on the basis of the benefits derived, or by a combination of any of these methods. At Milton, Wis., it is proposed to pay for the sewerage system by an assessment of 65 cts. per front foot and by a district tax of $20,000 to be spread over a period of 10 years by the issue of special improvement bonds. The assessments of benefits was made in proportion to the present assessed valuation. It is proposed to build about 80 per cent of the system at this time which will consume all of these funds.

Later, possibly 5 to 10 years from now, extensions will be needed on four or five streets leading into the country. The question has arisen, "Should the property not now receiving the full benefit of the system help to pay the principle and interest on these bonds; and if so, should their valuation remain as the others, or should it be cut down and how?"

In this case it was assumed that certain properties would have sewers in 5 years and certain others in 10 years. Their valuations were cut down in proportion to the value of a dollar at compound interest for these periods. While no one can say or prove that these times or this method is exactly correct, it is, however, a sound basis for adjustment and no doubt would receive better consideration in a court than would a mere guess without a reason for the guess.

DETERMINING THE PROPER EQUIPMENT FOR PUMPING STATIONS.

By Arthur L. Mullergren, Consulting Engineer, 555 Gates Bldg., Kansas City, Missouri.

The objective in the designing of a pumping plant is the selection and installation of such equipment as will give the most reliable and adequate service at the lowest possible cost, taking into consideration all fixed charges and operating costs. The modern pumping station is similar to the electric power station in that both are called upon to deliver essential commodities continuously and adequately at a minimum of expense. The pumping station is somewhat different in that reliability of service is the prime requisite as continuous service must be given at all times even at a sacrifice of economy. However, economy never has to be greatly sacrificed in a well designed station.

Three Principal Factors

The three principal factors to be considered in the design of a pumping station are in the following sequence: (1) Reliability; (2) Adequacy; (3) Economy.

Reliability can always be obtained by the selection of the best types of equipment known and by duplication of all parts throughout the installation. Adequacy can always be obtained by using liberal sizes of equipment and appurtenances. The economy, however, is affected by the first two factors, in that unnecessarily expensive equipment might be selected for the particular installation and avoidable duplication made, as well as by installing equipment too large for the particular requirements.

There is a happy medium that can be reached by properly proportioning and selecting the various equipment for each particular installation that will give amply adequate and reliable service at an economically satisfactory annual overall cost. Therefore, in the designing of a pumping station, the three factors mentioned above should be carefully weighed in the determination of each piece of equipment that goes into the station.

Inasmuch as the overall economy of a station depends upon delivering the required quantity of water at the required pressure with the least possible fuel and labor charges in addition to the fixed charges, it is important that careful consideration be given the various component parts of the station equipment so that the completed station will give the results desired. In some instances it is impossible to secure a highly economical installation, due to location of plant and space requirements. A water pumping plant must always be located with regard to the available supply, regardless of the desirability of the location from an operating standpoint. The location of a plant generally has some effect upon the type of equipment selected and consequently each particular location requires careful consideration. When considering the reconstruction or rehabilitation of an existing plant, a greater overall plant and system

economy may be secured by selecting a different site. In some cases it is possible to have a choice of a half dozen different locations from a water supply standpoint and in such cases, the determination of the site can be made from a purely operating standpoint.

Vertical Triple Expansion Crank and Flywheel Pumping Engines

There has been marked improvement of the design of pumping machinery and power station equipment in the last few years. Up until very recently, for very large pumping stations, the vertical triple expansion flywheel pumping engine has been pre-eminent from an economic and mechanical standpoint. This type of engine under favorable steam and water conditions has reached a duty exceeding 200 million foot pounds per thousand pounds of steam. These engines have been very reliable and the maintenance cost very low. However, they require very expensive buildings and foundations and the investment is very high. The installation of such engines is prohibitive in the smaller plants, owing to the very high fixed charges. The annual fixed charges on this type of pumping engine will exceed $700 per million gallon daily capacity.

Marked Improvements in Steam Turbines and Centrifugal Pumps

With the very marked development made in steam turbines in the last few years and the improvements made in the design of the centrifugal pumps, the steam turbine driven centrifugal pump has reached an overall economy that will exceed the vertical triple expansion flywheel pumping engine where favorable steam conditions can be obtained. There is no question now as to the reliability of the steam turbine, as the general electric power stations use this type of prime mover exclusively and have used them for a sufficient time to thoroughly demonstrate their usefulness as a reliable and economical source of power. There is no question as to the reliability of the centrifugal pump and the designers of these pumps have now increased the efficiency of them to a very high state,—reaching as high as 86 per cent.

One of the difficulties formerly encountered in the turbine driven centrifugal pumping unit was the gearing used to reduce the pump speed to a satisfactory point. The double helical reduction gear now employed for this purpose has overcome this difficulty, as such gears have an efficiency of 98½ per cent and operate with very little noise and maintenance and apparently have a life equal to the unit.

The steam turbine is admirably adapted to high steam pressures and high superheat, as well as a high vacuum. With the increasing tendency towards higher steam pressure and higher superheat, the turbine pumping unit will naturally benefit in economy to a greater extent than the reciprocating type of pumping engine; consequently, there will be an improvement in the duty of the turbine pumping unit as improvements in the boiler plants are made. Materials capable of withstanding a total steam temperature of 750 degs. Fahrenheit, are commercially used in turbines, boilers and piping, and this temperature seems to be about the commercially practicable limit at present, although there is considerable research work being undertaken to develop materials capable of withstanding much higher temperatures. The highest duty probably reached so far under an actual operating test by a turbine centrifugal pump was that of a 30 million gallon centrifugal pumping engine at the Mount Royal Pumping Station, Baltimore, Maryland. The duty reached by this engine on test was 170 million foot pounds per thousand pounds of steam, when delivering water at the rate of 45 million gallons per day at a pressure of 180 ft. with a steam pressure of 172 lbs. superheated 53 degs. Fahrenheit and a 28.9 in. vacuum. The city of Omaha, Nebraska, has recently contracted for the installation of a 50 million gallon per day 280 ft. head steam turbine centrifugal pump and the manufacturers have guaranteed a duty of 189 million foot pounds per 1,000 lbs. of steam based on 250 lbs. steam pressure at 150 degs. Fahrenheit superheat and 70 degs. cooling water. This duty is exclusive of the condensate pump and the whirling water pump for the hydraulic air ejector, which two pumps are direct connected on one shaft to a 24 brake horsepower steam turbine operating non-condensing. The duty included, however, all other auxiliary equipment used by the pump, condenser and turbine. The non-condensing steam turbine for driving the auxiliaries mentioned is used to secure a proper heat balance in the station. Consequently, the total station duty will not be affected and may possibly be improved.

Trend Toward Turbine Driven Centrifugal Pump

In most of the larger pumping stations

made in the last year or so, the steam turbine driven centrifugal pump has been installed. The tendency is decidedly towards the use of this type of equipment, and in view of the very recent marked improvements in economy and design, together with the improvement in economy that can be made by the use of higher steam temperatures, I predict that in less than ten years, the reciprocating type of pump will have a very limited field, and the number used will be negligible. Centrifugal boiler feed pumps, both steam turbine and electric motor driven are quite common now, and there has recently been developed a satisfactory small steam turbine for stoker drive.

The large central electric power stations have made great improvements in the overall plant economy. This improved economy has been secured largely through the improvements in the boiler plant equipment. An overall plant thermal efficiency of 18 per cent has been reached, and it is expected 20 per cent will be reached shortly.

Increasing Boiler Plant Efficiency

The boiler plant has always been and is yet the least efficient part of the pumping station or the central power station, and power plant engineers are making a great effort to improve the efficiency of this part of the plant. Larger boiler units are being installed with higher steam pressures and higher superheat. Furthermore, the tendency is to operate the boilers at much higher ratings, which keeps down the investment and fixed charges and the thermal efficiency of the boiler is not seriously affected. The central station engineers have been endeavoring to secure as near as practicable a perfect heat balance in the station, which of course, increases the overall plant economy. This is attained by utilizing the greatest possible number of heat units of the fuel and returning the condensate to the boiler at the highest possible temperature.

In a recent boiler installation made in a central station, the furnace walls were lined with cast iron blocks surrounding steam tubes through which the boiler water circulated. It is expected that the additional heating surface furnished in this manner will give a much higher overall boiler efficiency, due to the fact that more of the heat units of the fuel will be utilized. It is furthermore expected that the furnace maintenance expense will be reduced over the regular fire brick lining which is always a source of expense.

The judicious use of economizers has also considerably increased the boiler plant efficiency. Recent tests indicate that greater plant economy can be secured by bleeding the main turbine units at the lower stages for feed water heating than by using small steam non-condensing auxiliaries for this purpose; in fact better overall results were obtained by bleeding a sufficient amount to secure the required feed water temperature than by using economizers and steam driven auxiliaries or house turbines. This bleeding also relieves the lower stages of congestion.

Either electric driven or waterwheel driven auxiliaries can often be used to a better advantage from an installation as well as an economic standpoint. In water works stations the waterwheel driven auxiliaries with hydraulic air ejectors, returning the cooling water to the suction of the main pumps, offer simplicity and economy. However, only the very largest pumping stations would warrant a boiler plant installation similar to that used in the best type of central stations, but in many cases it would be possible to secure a greater overall station economy by the use of central station methods and equipment adapted to the particular condition.

Boiler Room Meters

There are now on the market meters for the boiler room that will record fairly accurately the various operating conditions of the boiler plant, thus making it possible to check up any unusual loss occurring therein. A modern boiler room should contain all such meters as will enable the operating engineer to tell the condition of his combustion, water temperatures, output and any defects in his equipment. While we are at present getting good thermal efficiencies out of our individual boiler plant equipment and the prime movers, there is room for considerable improvement in the overall plant economy. A gain of a few per cent in efficiency in each part of the plant may mean a considerable reduction in the total annual expense. Consequently, when it is possible to make a small gain by improvement to any part of the plant equipment, it is advisable to do so, as the various improvements made regularly, will ultimately make an excellent showing in the plant operation.

The Station Considered as a Unit

In the determination of the equipment

for a pumping station, there has been a tendency to select a very highly efficient pumping unit sometimes without regard to the adaptability of the unit for the conditions under which it will operate, and particularly without regard to economic considerations, and at the same time the boiler plant equipment and auxiliaries are selected with very little thought. The pumping station should be considered as a unit and all equipment entering into its construction should be carefully selected with regard to the adaptability and economy of the various parts with respect to each other and to the whole. Much publicity has been given at times to the very high thermal efficiency reached by some pumping units, and in some cases the overall thermal efficiency of the plant has been commented upon. Our goal has apparently been to secure a high duty per B. T. U. If the efficiencies of some of these plants had been measured in duty per dollar of annual charges, they probably would not have made such a satisfactory showing. After all, the duty per dollar of annual charges is the true measure of efficiency of the pumping station, and in the selection of the equipment for a station, this should be the basis for the determination.

Since the development of the central station to its high degree of efficiency and the extensive transmission systems emanating from such stations, there are conditions where electric motor driven pumping plants would show a considerably higher duty per dollar of annual charges than a very highly efficient steam plant. This is particularly true in the smaller installations and where electric power is available at reasonable rates. Where synchronous motors can be used, central stations are offering attractive rates to the water pumping plants, as this type of motor assists in correcting the power factor of the transmission system, and the hours for pumping can be, in a great many cases, arranged to suit the central station.

Motor driven centrifugal pumping units have been installed that have shown a combined overall efficiency of 82 per cent, which is a very good showing when we consider that the mechanical efficiency of a vertical triple expansion flywheel pumping engine is about 93 per cent. Reliability of service is one of the principal reasons that electric drive has not been more generally adopted. However, with the duplicate or loop transmission lines and interconnected central stations, practically as great a reliability as the self-contained plant will be secured. Furthermore, emergency equipment operated independently by an inexpensive steam or oil engine installation may be provided, thus insuring absolutely continuous service, and by carrying the fixed charges on this emergency equipment together with the small amount of operating expense that may be incurred in its operation, plus the regular operating expenses and fixed charges of the electric driven plant, the annual charge of the entire installation may be considerably under the annual charge of a highly efficient steam plant. Some of the larger central stations have their plants installed at the coal mines and own these mines, consequently their fuel costs are not subject to the wide fluctuations of the average water pumping plant, and as a result, by considering the annual operating and fixed costs over a period of years, the purchase of electric power will in a great many instances show up considerably under that of producing the power. Superpower plants and systems are being built and the greater the system, the greater the advantages of purchasing power over producing it with isolated plants. The pumping stations located in these superpower zones may well look to electric driven equipment, or a composite electric and steam driven plant so arranged and operated as to take advantage of the low power costs, low fixed charges, flexibility and simplicity of operation.

The Oil Engine

The Diesel type oil engine has been developed to a very high state of efficiency and reliability and in certain localities, this type of pumping plant would probably make an unexpected showing, insofar as the annual costs are concerned. The investment in this type of equipment is very high, but the fuel economy is high,—such engines reaching a thermal efficiency of 35 per cent, and in localities where coal is very expensive, and electric power is not available at satisfactory rates, it would pay to investigate the feasibility of such an installation before definitely determining upon any type of plant.

In stations having a daily capacity of 10 million gallons and above, and with coal costs around $6 per ton, the high pressure steam driven centrifugal pump will ordinarily show the best duty per dollar of annual charges, over any other isolated type of plant. In plants below

this capacity, each particular installation would require a thorough investigation and a careful balancing of all costs, before a definite type of plant could be decided upon. It is generally recognized that in plants of three to five million gallon daily capacity, that the cross compound flywheel pumping engine will make the most favorable showing. In regard to thermal efficiency, this may be very true, but it would not hold in every case if the duty per dollar of annual charges was considered.

In conclusion I might say that definite annual cost data on each type of plant for different conditions would be of considerable value in supporting the foregoing, but there are so many different conditions and so many different types of plants that could be considered for each particular condition, that it would require considerable space to present it. The point that I wish to emphasize in this paper is, that in the selection of the various equipment entering into a pumping plant, that instead of endeavoring to select the individual plant units having the highest thermal or mechanical efficiencies, or even securing the highest total plant duty on a heat unit basis, that the completed plant should give the highest duty per dollar of annual charges, in which would be included all operating expenses, maintenance, interest, depreciation, insurance and any other fixed costs, and at the same time taking into consideration the reliability, adequacy and future growth of the plant.

The foregoing paper was presented at the recent annual meeting of the American Water Works Association.

RESURFACING RIGID PAVEMENT WITH BRICK AT BETTENDORF, IOWA

A practical method of economically salvaging rigid pavements that have been worn to a condition of extreme roughness, has been adopted at Bettendorf, Iowa, a suburb of Davenport. A hard surface pavement that was laid eleven years ago, but which has been in bad condition for the last seven years, is now serving a useful purpose as a base for a new pavement. City Engineer N. H. Tunnicliff, has solved the problem of repairing the pavement by resurfacing it with vitrified paving brick and thus making practically an entirely new pavement of it. The rebuilt pavement will have the many advantages that an asphalt filled brick pavement is recognized to possess such as flexibility, durability, long life, and low repair costs.

The road now being paved is part of the main artery out of Davenport, leading northward along the west bank of the Mississippi river. About three miles from the heart of Davenport, the road passes through Bettendorf, a small municipality quite widely known for the car shops which are located there. Other plants are also located in this manufacturing city.

In Bettendorf the street is about 50 ft. wide between the curbs and carries two street car tracks. The roadway on each side of the car tracks measures approximately 18 ft.

City Engineer Tunnicliff specified a 3-in. vertical fibre, lugless brick pavement, asphalt filled by squeegee method. The specifications are being successfully complied with in the requirement that no more than a paint coat of filler is left on the top surface of the brick. Torpedo sand is applied after the filler is placed.

The brick surfacing was specified to be laid on 1-in. cement-sand bed, 1:4 mix, spread over the old 6-in. concrete pavement, which was to remain as the base for the new street. Extra material is used to fill depressions in the old base.

The contract was let at $2.425 a square yard to the Central Engineering Co., of Davenport, with the stipulation that where extra material was required in cracks, holes, etc., the additional amount would be paid for at $10 per cu. yd.

The total pavement includes approximately 28,000 sq. yds. Brick furnished are of less than 22 per cent loss on ratler test.

When the street car tracks were relaid several years ago, it was anticipated that the old pavement would eventually be surfaced with brick. Thus the tracks were laid higher than the level of the pavement.

TACKLING THE STRAY CURRENT PROBLEM

By C. E. Schutt, Consulting Electrical Engineer, Krehbiel Co., 730 W. Monroe St. Chicago, Ill.

When man discovered fire he soon learned to make use of it. He learned also that it was capable of doing great damage if left uncontrolled. It is in a somewhat similar position that man finds himself with regard to electricity. It is

a destructive agent when left uncontrolled.

It has long been known that a current of electricity in passing from a metal into an electrolyte does so by carrying a portion of the metal along with it. Much of the research done in regard to this action and its characteristics has been in the line of industrial applications. Numerous processes have been developed for electro plating, and for electrical separation and recovery of metals and around these processes great industries have been built.

The same kind of work is being done by stray currents that flow in pipes and other metal structures buried in the earth. This work is demonstrated by the rapid destruction of metallic bodies located at certain points in the earth where the electric current flows from such bodies into the earth on its way to the power station.

When a metallic body is buried in the damp earth or is placed in contact with the earth there is present all the mechanical apparatus necessary to produce electrolytic action. All that is necessary actually to produce this action is to force an undirectional electric current from the metallic body into the surrounding earth. The amount of metal carried away by the current will depend upon the quantity of current flowing. The metallic body will gradually disintegrate, and there will appear, in the case of iron, a deposit of rust or iron oxide. This process is known as electrolytic corrosion. In practice conditions favorable to such destructive action, is found where pipes, cables, bridges and structural steel are in contact with the earth in such relation to a grounded power circuit that current tends to flow from the conductor into the metallic structure and then from the structure again into the earth. It is at the points where the current leaves the metal that the metal is eaten away.

There have been many theories advanced regarding damage to underground metallic structures by electrolytic action. So many of these theories have been so biased by the point of view of the individual that they are of little practical value in the solution of the problem of minimizing the damage. Other theories are comparable to some of the early theories of fire. One of these theories which held a strong position was that since fire went up there must be a lot of fire above the earth. Proof of the theory was that the Gods threw it down in the form of lightning so that man would have it to use again. Not so bad in the way of an argument and it compares favorably with many theories elucidated today without being able to get at experimental facts to substantiate them.

It is now well recognized that electric currents flowing in the earth and in grounded bodies are a source of very great damage. Experimental work has been carried on by very responsible organizations and data is available upon which to intelligently attack the problem from an engineering standpoint. Many of the false notions are disappearing and a rational method of approach is taking its place.

The money spent on fire prevention and fire insurance greatly exceeds the loss by fire in our cities. If these measures were not taken cities would be burned to the ground as fast as they could be built. The money spent on the control of stray currents is on the other hand almost negligible when compared to the damage and loss. The damaging work of corrosion goes on very quietly, and does not make a display like a fire, but the same corrosion has allowed many a fire to become spectacular by the breaking of weakened water mains under fire pressure.

It is safe to say that there is today no known panacea for all the ills of stray electric currents, that is, there is no one remedy that can be applied to all cases. In fact a remedy that is practical and may give the required measure of relief in one case may greatly aggravate the trouble in another case which appears to be identical. Again remedies that serve to protect one structure may cause added hazard to neighboring structures. Cases have been noted by the writer where remedies have been applied to protect one pipe system which has produced bad conditions for other underground structures in the same territory. Yet a company can not be criticized for protecting its property in the best possible manner. Like conditions will continue to exist and all utilities will suffer so long as each fellow stands in his own back yard and tells the other to get off the earth.

Each of the utilities is quite as essential to a city as any other utility. A city could not long exist without any one of them. If each interest cares for its problem independently then each is partly

undoing the work of all the others and a condition arises where money is being spent in producing systems that afford relief only temporarily. One can readily imagine the confusion that would arise where a cable company in a given territory has applied a drainage system to the cable sheaths, a pipe system has been provided with insulating joints and the railway company then installs a track drainage system. The three systems are in many ways in conflict.

A great many cases of very aggravated electrolytic trouble can be greatly relieved by very simple and inexpensive means when once the source and exact nature of the trouble is known, but too often the nature and seat of trouble is guessed at and the wrong remedy is applied. This is an expensive way of going at the problem for not only is a company likely to spend a lot of money uselessly but the damage is quite likely to be increased.

United effort on the part of all interests including the offenders and the injured would go a long way in simplifying the problem of controlling stray electric currents. Where such interests can meet in a spirit of live and let live they will find that everything can not be done to the exact liking of one party, but that with a certain degree of tolerance very acceptable results can be brought about and stray currents from any source can be so controlled that very little damage will result.

MUNICIPAL TEAM WORK IN INDIANAPOLIS

By Frank C. Jordan, Secretary, Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.

We hear a great deal about the popular latter day mysterious and intangible thing called "public relations." We listen to, and read, long and expert papers on the subject, but down under the surface we gloss over with phrases, is the undeniable fact that public relations, so called, consist of nothing more nor less than neighborliness. The water works operator who is a good neighbor to all his community, who treats his neighbors fairly, serves them well, charges them properly and carries his share of the community load in all respects never has one of these lately discovered public relations problems.

The utility operator who works with his city officials as one neighbor with another, never has such a problem. If he is acquainted with these city officials, as one neighbor knows another, it follows that the officials will know his problems of operation and will sympathize with him as one neighbor with another. It is only when we keep away from the officials, and behave as perfect strangers to them, that difficulties arise.

There may be some who will say that it is well to keep a respectable distance between city or state governmental officials and the utilities. The trouble with this theory is that this distance leaves space that may very quickly and readily become filled with misunderstandings, mistrust and even enmity.

It all simmers down to this: The problems of the utility, which are service and rates, are community problems. The utility cannot solve either one by itself; neither can the community, through its city or state officials. Both problems are bigger than either the utility or the officials. They must be solved for the common good of both; therefore, the thing to do is to maintain friendly and neighborly relations towards each other. Such neighborliness tends towards Municipal Team Work.

Fire Department Relations

In an attempt to bring about efficient Municipal Team Work in the city of Indianapolis we became neighborly with the various city departments and the results have been most gratifying. We held neighborly conferences with the Fire Department, and these have resulted in a more efficient public fire service. In a neighborly way we invited the Fire Chiefs, Fire Captains and Lieutenants to visit our plants and they accepted our invitation. They evidenced great interest in the operation of our pumping units, boiler room, etc., and a great majority of them confessed that it was their first visit to any of our properties.

We returned their call and many of our men had to confess that it was the first time that they had had the opportunity of receiving first hand information in regard to the trials and tribulations of a city fireman. This neighborliness has made their problems our problems, and our problems their problems. In one of our neighborly conferences, the question of decreasing our fire loss came up for consideration and it was only natural that we should join hands in a Fire Prevention program and the Indianapolis Fire Prevention Campaign was the result of these neighborly talks.

Fire Prevention Campaign

During the first 18 months of our Fire Prevention Campaign we held neighborhood meetings in every section of the City, and through the instrumentality of moving pictures, addresses and contests, the value of fire prevention measures was impressed on the minds of the Indianapolis public and they are now evidencing an exceptionally fine spirit of co-operation as the result of these little meetings when two or three hundred neighbors gathered in a fire engine house or public school building to plan for a cleaner and safer Indianapolis. At this time our attention is largely centered on a Clean-Up and City Beautification program and a campaign for the Elimination of the Wooden Shingle Roof, and we are receiving most satisfactory support from the great majority of Indianapolis citizens. During 1922 the building commissioner issued approximately 4,000 re-roofing permits, and at the present rate this number will be almost doubled during 1923. In this great campaign for a cleaner, safe and healthier Indianapolis, we have witnessed Municipal Team Work second to none in the history of our City.

Insurance Reclassification

History has shown that it is rather unwise for one neighbor to point out the defects in another neighbor's household, and bearing this fact in mind, we called in the National Board of Fire Underwriters to make a most careful study of the fire and water departments and we then joined in a neighborly effort to eliminate these defects which were brought to our attention by the exceedingly efficient gentlemen from the National Board's office. A movement is now on foot to give Indianapolis a re-classification in its insurance rating, and our citizens will profit because of the Municipal Team Work in building up the public fire service.

Board of Health Relations

We held some very pleasant conferences with the City Board of Health, and in a consideration of the physical conditions in Indianapolis we discovered that many of our citizens were under-privileged in that they did not have the privilege of living in modern homes equipped with bath, toilet and other modern sanitary conveniences. In company with city officials, we visited several of these properties and found that many of these under-privileged citizens were very desirous of making their properties modern but that their financial condition precluded such a transformation. The Board of Health gave consideration to the enactment of very stringent measures, which would compel the installation of sanitary conveniences. A brief consideration of this proved that it would not be the neighborly thing to do unless the City was able to show that these conveniences could be installed without considerable financial embarrassment to these underprivileged citizens. A few more neighborly conferences were held and a plan was formulated under which plumbing is being installed on the payment plan and a sanitary program of vital importance to the health of Indianapolis is being carried through with practically no friction whatsoever.

The City Health Department is morally obliged to rid the city of disease breeding places, and the Water Department must bear a share of the Health Board's obligation in this matter. It is, therefore, of vital importance that some financial arrangements be made under which every citizen may have the benefit of thoroughly sanitary quarters. The payment, or budget plan, is being utilized by quite a number of our citizens and we have found that an advertisement of the payment plan of plumbing installation is all that is necessary to bring people to the plumbing supply house. and in many cases they are able to take care of the financial arrangement without resorting to the payment plan. This budget plan is working very satisfactorily and is serving a great purpose.

Water Rules and Regulations

In one of our neighborly conferences with some of our patrons, some question was raised in reference to our rules and regulations. The friendly advice of the Public Service Commission was sought and as the result of some further conferances a committee, consisting of bankers, manufacturers, lawyers, club women, water works men, college professors and other citizens to a total of 25, met, in a neighborly way, to formulate water works rules which would be fair both to the utilities and the balance of the public. This committee has held several meetings and these rules are about ready for submission to this Association and to the Public Service Commissions throughout the country. The fairness of these rules is an indication of the public's desire to be fair when the utility presents its case in the right manner.

In our program of co-operating with the Board of Public Works in the up-building

of our City, we have been called upon to make very large expenditures in water main extensions, many of which are not paying investments but which are of inestimable value to the Indianapolis citizens. In carrying out such a program, entailing large expenditures, it is necessary for the state and city authorities to pursue a broad-gaged policy.

In an attempt towards neighborly cooperation with the Park Board we have done a considerable amount of work in beautifying the grounds around our pumping stations and we are looking forward to the day when every part of the water company's property will be a beauty spot and will mould itself into the great plan of city beautification.

Public School Relations

We have most friendly relations with the school children and the publicity which they have given us is of tremendous value. Every pupil in the upper grades is required to write an essay on the public water supply of our City, and during the course of the year a great many of the classes visit our filtration system and pumping stations and very little of interest escapes their notice. We recently furnished the school children with pamphlets descriptive of our property and these pamphlets are being utilized as the foundation for thousands of essays. A great many of our new patrons volunteer the information that a school boy or girl in their home has insisted upon having sanitary conveniences in the home and in this, and other ways, it has been demonstrated to us that the water company can have no more valuable asset than the good will of the school children of the city.

Our City is blessed with an exceptionally large number of civic and commercial organizations, the records in the local Chamber of Commerce showing a total of more than one hundred groups of people organized for the purpose of up-building the City. One of our many trips of inspection included representatives from 92 of these organizations and no publicity expenditure made by our Company has been productive of better feeling than this inspection trip when men and women from every section of Indianapolis spent a full afternoon and evening in an inspection of our properties and a consideration of the future development of the public water supply.

It has been gratifying to find that our attempts at neighborliness have been reciprocated in a greater degree than we had any reason to expect. Almost without exception our citizens have assumed a most neighborly attitude and there is being carried forward a Municipal Team Work which is resulting in great good to our City.

The foregoing is from an address by Mr. Jordan before the recent annual meeting of the American Water Works Association.

WATER WORKS PUMPING STATION DESIGN

By Charles B. Burdick, of Alvord, Burdick & Howson, Engineers, 8 South Dearborn St., Chicago, Ill.

It is the purpose of this paper to outline the general principles of pumping station design and to cite a few examples of recent construction, referring more particularly to the buildings for housing water works equipment.

The average water works involves an investment not less than $35 per capita or say $3,500,000 in a city of 100,000 people. Of this large investment often not more than 25 or 10 per cent represents structures visible to the eye of the ordinary citizen. To the casual observer water works buildings present the only visible evidence of the excellence of the plant, except the water delivered, and his impression as to the property is likely to be based upon what he can see.

Fundamentally there is no reason why the water works station should not present the same attractive appearance as the City Hall or any other municipal building. It should be permanent, clean, and as easily kept clean as a modern hospital, for it handles a commodity used in every home. An ornate design justified in a City Hall or a Courthouse would be out of place in a pumping station. Rather it should represent the masculine in architecture without undue pretention, strong and permanent in its lines and materials, frankly adapted to its purpose, and presenting an appearance agreeable to the eye. This will require compliance with laws of good architecture. Appearance must not be neglected in structures likely to live a long time.

Permanence

Water works construction is now sufficiently standardized so that it is possible to lay out pumping plants subject to enlargement in such manner that the buildings may be useful indefinitely. The pumping and power equipment should be arranged with the idea of expansion. It

is usually practicable to build only for a moderate time in the future, but it costs little to lay down the indefinite future additions on paper, and so to locate the building, and so to arrange the equipment that extensions may be made without destroying the usefulness of important parts of the plant. It is all too common to find layouts that have expanded piecemeal according to the path of least expense, which must be torn out and rebuilt, because further expansion is impracticable. We can see farther into the future today than was possible a generation ago. There may be radical improvements in water works equipment hereafter, but if the general plan of expansion has sufficient elasticity, the probable future can be accommodated.

In the ordinary water works plant, steam operated, there is, first, the heart of the plant, so to speak, consisting of the main entrance, offices, and possibly a laboratory which may be grouped, and will need little further expansion. The engine room and the boiler room after providing for the present and the immediate future may be expanded along parallel lines without necessarily spoiling the architectural symmetry. It is wise to be liberal in selecting dimensions. This tends toward permanency.

If the water is filtered, it is desirable in small pumping stations to centralize the "business end" of all the station operations on account of facility in supervision. This complicates the design, especially the provision for future expansion, and centralization is not always possible when filtration is added to an old water works. In the layout of a new plant, however, it is practicable so to co-ordinate the expansion of pump room, boiler room, filter plant, coagulation basin, and clear well, that each may be enlarged in an orderly manner with convenience of access between the operating parts and the administrative center of the group. Basins and reservoirs may expand, if necessary, forward from the building, utilizing a space covered over by lawn. Plants in cities up to 100,000 population, or somewhat more, may thus be designed without the necessity for separating the pumping and filtration plants. A compact arrangement is quite necessary for economical operation in a small city where it may be desirable to operate filters without adding to the number of employes.

Fireproof Construction

The modern water works station is fireproof throughout for obvious reasons. Permanency requires it. It should be the last building to burn in any community. Many water works stations are practically fireproof except for the roof construction, windows and the doors. It is practicable to build stations today without using a stick of wood, and at moderate costs as compared to wood. Millwork has increased in price to such extent that there is little difference between wood and metal frames, and concrete and tile construction is generally used for roofs in the most modern stations.

Building Materials

For underground structures or for other structures, more or less concealed and protected from the weather, concrete gives excellent service. Where exposed to view or subjected to the action of the elements, it is not proving a satisfactory building material. Wherever possible it is wise so to design reservoirs that they may be filled over and sodded, thus protecting the concrete from the expansion and contraction of hot sun and winter cold, and incidentally better protecting the water from extremes of temperature.

For superstructures, brick and stone are the most satisfactory materials for exteriors; terra cotta may be useful upon the interior or exterior. Upon the interior the surface should be clean and non-absorbent. Concrete floors are satisfactory only in the cheaper structures where they may be successfully used if covered with a heavy non-absorbent paint especially adapted to concrete. In the better stations terrazzo or tile is justified.

Walls, particularly where damp, as in the pumping pits, should be faced with a non-absorbent substance such as enamel brick built at least head high. Above this plane pressed brick is satisfactory. At present a rock plaster is available almost as hard as stone which can be worked into very attractive panel designs at moderate cost.

For the roof, exposed steel trusses are generally used with steel purlins and a roof covering of reinforced concrete or tile. In order to prevent sweating in cold weather a double ceiling is desirable. This may be accomplished by rock plaster on metal lath hung from the purlins. Thin concrete roofs usually become a nuisance at certain times from dripping. A single thickness of 5 ins. is usually sufficient to prevent the serious collection of drops. A double ceiling completely eliminates the trouble and costs

comparatively little more. Skylights and ventilators must be guarded with gutters for satisfactory results.

It is proposed to cite a few examples of recent pumping station construction with figures of cost. Practically all of this work has been done in co-operation with Mr. Victor A. Matteson, architect, Chicago.

Des Moines Pumping Station

The new 21st street pumping station at Des Moines is a steam station. It pumps the entire water supply of the city in one operation from the ground water collecting galleries into the pipe system against direct pressure. The rates of pumpage at the present time are as follows:

Minimum night rate M. G. D.	6.5
Average Day M. G. D.	10.0
Momentary peak	18.0
Maximum fire demand	24.0

The pumping plant consists of three DeLaval turbo-centrifugal geared units, two of 15, and one 25 million gallons capacity. These pumps operate at 269 ft. total head with 200 lbs. boiler pressure and 100 deg. of superheat. The two smaller of these pumps developed duties on test ranging from 150 to 114 million foot pounds per 1,000 lbs. of steam at full capacity and half capacity respectively. The larger pump is guaranteed to deliver 161 mil. duty at full capacity, 164 at three-fourths capacity and 144 at one-half capacity.

Boiler Plant: The boiler plant consists of four 323 H. P. Springfield water tube boilers. One boiler is served by a LaClede-Christy natural draft chain grate stoker. Three boilers are equipped with Harrington chain grate stokers operating on natural draft up to 125 percent rating, and forced draft up to 200 percent rating. The plant burns a low grade of bituminous screenings (Poke County, Iowa), ranging from 8,000 to 10,000 B. T. U. The individual boilers and stokers in this plant developed on test from 72 to 74 percent efficiency when operating on natural draft slightly above boiler rating, and 70 percent on forced draft at slightly under 200 percent rating.

This boiler and pumping plant serves the city on about half the tonnage of fuel per unit of water pumped required by the old pumping station, served by hand-fired tubular boilers and compound crank and flywheel pumps. The greater part of the saving is secured by the improved boiler plant.

Coal Handling: The matter of handling coal is a difficult one in a water works boiler plant by reason of the magnitude of the peak load as compared to the comparatively small average load. Coal handling equipment of the type adapted to electric lighting practice often fails to show economy when applied to the small tonnage burned by water works, on account of fixed charges. The device adopted at Des Moines consists of a gantry crane feeding from cars or coal pocket to an overhead bin in the boiler room. It also picks up ashes dumped to the ash pocket by hand, loading the same into cars or trucks. By the use of this crane one man unloads all cars not dumped, and handles all coal and all ashes for a 24 hour shift in three hours or less. The coal handling scheme at Des Moines at the present price of labor a little more than "breaks even" with hand coal handling labor, fixed charges considered. Its installation was considered warranted in view of the probable future increased cost of labor.

Building Group: The group of buildings comprising the new water works pumping station at Des Moines consists of the main pumping station and boiler room, a shop and garage building for the accommodation of all automobiles and trucks used by the Water Department, a warehouse, with pipe yard adjoining, for storing pipe, fittings and miscellaneous supplies; also a group of cottages housing four families of water works employes.

The main pumping station consists of a pump room containing space for eighty million gallons in pumping capacity. Fifty-five million gallons capacity is at present installed. The boiler room contains 1,300 H. P. in boilers and space is provided for enlargement that may be required after 1940.

Adjoining the main entrance to the pumping station are located an office for the chief engineer, a laboratory, and toilet accommodations for the public. Employes' toilet rooms are located between the pump room and boiler room. Galleries are provided in the pump room for the accommodation of visitors, so that the pump room may be seen without interfering with the operation of machinery.

All foundations are constructed of heavy reinforced concrete. The pumps are set 13 ft. below the high water line, thus necessitating a heavy pump pit floor and walls to resist upward and inward pressure. The pumps are thus located

in order to draw from the gallery system in extreme low water.

The pump room is finished with terrazzo floors and white enamel brick walls up to the top of the wainscot at grade line. Above this point the walls are paneled and coated with rock plaster. The roof is supported by steel trusses carrying Federal cement tile with a composition roof covering. Steel windows, doors and trim are used throughout.

The boiler room is finished with concrete floors, with walls of common brick painted. The entry way and halls are floored with terrazzo, and provided with terra cotta walls. The exterior of the building is of dark red tapestry brick with Bedford stone trim.

The shops and garage building exterior finish is similar to pump house. The interior is finished with concrete floors and common brick walls, and the whole is surmounted by a timber mill construction roof, slow burning type, and covered with composition roofing. Steel window sash are used. The remaining millwork is of wood. This building provides all facilities for the maintenance of the water works motive power and contains a wood shop, machine shop, paint shop and in the rear a stable for the accommodation of one team.

The warehouse building resembles a small freight house in general plan with an office space in the front where all water works labor is handled and assigned to its daily tasks. A siding runs parallel with the warehouse with platforms on both sides, so that freight unloaded may be wheeled through the storeroom and loaded on wagons or trucks. Heavy freight such as pipe and large fittings may be unloaded from the opposite side of the cars and stored in the pipe yard. This building is surmounted by a mill construction wood roof. Floors are of concrete and the office walls are plastered. Wood millwork is used throughout this building.

Three wood and stucco English cottages provide for four families. One cottage contains five rooms, one cottage six, and one double cottage contains two six-room apartments. Each apartment is provided with concrete cellar, furnace heat, plumbing, maple floors, plastered exteriors and shingle roofs. These apartments are rented to employes at cost. The rent charged is $30 per month per apartment exclusive of heating and light.

Orlando Water Works and Light Plant

At Orlando, Fla., the new station is now nearing completion. This accommodates the water filtration plant of four million gallons capacity, electrically driven centrifugal pumps of 12 million capacity augmented by four million of steam pumping capacity in another station. The generator room contains 4,000 K. W. in turbo-generators with space for 2,500 additional K. W. The boiler room contains 1,500 H. P. in boilers, oil fired.

The Spanish type of architecture was used, as especially adapted to a warm climate. The boiler room is open on the rear, the boiler fronts being protected by open archways. The walls are of brick with exterior cement plaster. Roofs are supported on steel trusses with concrete slabs and composition surface. Red tile is used for sloping roofs and wall caps. The interior of the pump room is plastered. All other wall surfaces are of common brick painted. Floors are of red quarry tile.

Table I shows the cost of the Orlando building, including filter house and concrete filter beds; also clear water reservoir underneath the filters, but does not include cost of filter equipment or any other equipment of the plant except as stated in the tabulation.

Manistique Tower

The opportunity was afforded at Manistique, Mich., to combine a small electric driven pumping station and a water tower. The water supply at Manistique is delivered by gravity, substantially at ground height, to the center of the town, where it is pumped electrically into a steel elevated tank surmounting the pump house.

The land occupied by the pumping station was donated by a public spirited citizen upon condition that an attractive station and tower should be built. Manistique is a small city with a population about 7,000. A plan was worked out which accommodated the necessary electrically driven pumps in the base of the tower, and the saving thus effected permitted enclosing the tower in an attractive envelope. The cost of the structure thus built is approximately equivalent to an uncovered steel elevated tank plus a separate building of fireproof construction.

The steel tank contains 200,000 gallons. The top is located 107 ft. above the ground. It has a hemispherical bottom and is supported on the brick work 64 ft. above ground by means of eight short legs horizontally braced. The tower is constructed of brick with red tapestry

face brick. The trimming on the lower portion of the tower is Bedford stone and the cornice is constructed of reinforced concrete cast in place. The dome is of zinc supported on wood trusses.

The tower is octagonal outside and 16-sided inside. The brick cross-section is sufficient to support the superimposed load with a unit pressure not exceeding 175 lbs. per square inch.

The 16-sided pump room is 33 ft. in inscribed diameter. It is floored with terrazzo with white enamel brick wainscot, and rock plaster walls and ceiling. A false roof is provided over the pump room with drains to catch any drip or leakage from the elevated tank. A cellar under the pump room accommodates all pipes, heating and plumbing equipment.

The electric pumps are pressure controlled from the tank and start and stop automatically. No attendant is required in the operation of the plant except for periodical visits for inspection and oiling.

Gary Station and Water Tower

The Gary pumping station and water tower, although built a number of years ago, is an example of what is possible in the use of concrete.

The water tower is simply a housing for a steel elevated tank supported on vertical steel legs entirely independent from the envelope. This plan was followed on account of the necessity for haste in providing a water supply for the city during the building period. The concrete envelope was added later. The shaft of the tower is of reinforced concrete with a concrete dome roof. The base of all cornices and the facing on the lower one-fifth of the tower is of precast concrete applied in the usual manner where stone is used. The shaft proper is of reinforced concrete with a reinforced concrete dome roof.

The pumping station has concrete foundations. The pump room is depressed below the ground level and is lined with white enamel brick. Above grade walls are of brick with buff pressed brick interior face, and precast concrete exterior face. The exterior face blocks are of two colors, gray and dull red.

Ashland, Ky.

The Ashland, Ky., plant exemplifies construction for a small city. It includes an electric driven pumping station with gasoline reserve pump; also a water filtration plant. Construction throughout is entirely fireproof and of good appearance, but no extra money was spent for the sake of appearance.

The entrance to the plant is through the operating floor of the filtration plant. The filter beds produce a terrace effect.

Upon the Ohio river the intake problem is important on account of the extreme variation between high water and low water. The low lift pumps are located in a pit 26 ft. in diameter and 43 ft. deep. They consist of two motor driven centrifugals and one high speed gas engine centrifugal, each 2½ M. G. D. against 65 ft. head. Three pumps of the same kind of capacity operate against 275 ft. head when pumping to the city. These pumps and the filters are installed on the roof of the clear well.

The filtration plant consists of four beds, total capacity 2 2-3 M. G. D. High velocity of wash is used from a 35,000-gal. steel wash tank set on the roof of the pump pit.

Ironwood, Mich.

This plant develops a ground water supply from driven wells and pumps it against a head of 650 ft. through a four-mile pipe line of 16 ins. diameter. The water is developed from three shallow well groups, each sub-station containing a 2 M. G. D. pump. The main pumping station contains two three million gallon electric driven centrifugals and one and one-half million gallon high speed gas engine driven centrifugal. One gasoline driven centrifugal is also installed for reserve low lift pumping.

The buildings connected with the Ironwood water works are all constructed from boulders picked up on the water works lot. The saving thus effected as compared to brick was nominal, but it is believed that these buildings present better appearance than would brick structures in the locality where built.

The main pump house has walls of boulder stone plastered inside on metal lath and painted, floors of concrete painted, and the roof is slate on wood with matched and beaded ceiling oiled, and exposing steel trusses. Three similar sub-pumping stations were built and as the plant is located some distance from habitation, it was necessary to construct two six-room dwellings also built of boulder stone.

Prairie Du Chien, Wis.

This plant represents the practicabilities in a small town where the funds available for water works construction were quite limited. This pumping plant consists of a concrete pit 45 ft. inside diameter by 24 ft. deep surmounted by a mill construction wooden roof with a

small brick building attached to the pit at the ground level for office and shop purposes.

This plant is electrically operated. Water is sucked directly from four driven wells immediately outside the pit wall and discharged into the pipe system which is connected to an elevated reservoir on the adjoining bluffs. The pumping installation consists of one motor driven centrifugal 500 G. M., 340 ft. head, one 600 G. M. high speed gasoline engine centrifugal, and one 600 G. M. motor driven triplex pump moved from an old pumping station. Space is provided for a fourth pump at some time in the future.

All foundations are of reinforced concrete. The superstructure and the parapet around pumping pit is common brick with moderate priced face brick. All sills, lintels and caps are built of precast concrete. All roofs are of wood construction. The composition roof covering of the pit is concealed by the brick. The roof of the office and shop structure is finished with cement interlocking tile. Concrete floors are used throughout. Interior walls of brick are painted.

Cost of Pumping Stations

The cost of the pumping stations that have been described and several others are shown in Table I. As the prices of labor and material have fluctuated quite materially during the period in which these stations were built there is shown in the table the date of the contract, the price basis at the time and the price basis at the present time. The table also shows the cubic foot cost of the stations as of the time when let and as of the present time. In computing cubic foot cost the contents of the building have been figured based on outside measurements and taking the height from the footing level to the average outside surface of the roof for each part of the building.

The tabulated price basis is the average cost of building materials as published by the U. S. Department of Labor. This refers to the average prices of 1913 as 100 per cent. The use of this price base presupposes a fluctuation in labor equal to the fluctuation in material price. The price of labor generally fluctuates less than the price of material. However, it is true that the efficiency of labor enters into contract cost and it is generally true that when materials are high labor is scarce and its efficiency decreases, therefore tending to make labor cost more nearly fluctuate with the prices of materials. Apparently the assumption made regarding labor does not seriously affect the comparisons of cost, for the unit prices appear to line up very well in the comparison of buildings.

Comparison of Costs

In comparing the costs of buildings there are innumerable factors that might be considered. Pumping stations, however, are generally similar in type and vary principally in dimensions and in the degree of finish. In theory the cost of roofs and floors varies directly as to area and that the cost of walls increases 43 per cent in doubling the area or decreases 14 per cent when the area is cut in half. These proportions hold only for perfect equares, but the difference is small for an ordinary rectangular building. Miscellaneous details such as plumbing and

TABLE I—COST OF PUMPING STATION BUILDINGS

	Cost	Contract Date	Cu. ft. —(Thousands)	Cost per cu. ft.	*Cost Price Base	*Present Price Base (Mar., 1923)	**Present Cost per cu. ft.
PUMPING STATIONS—							
Des Moines, Iowa	$220,479	1920-23	810	27.0c	178	198	30.0c
Ashland, Ky.	34,194	Oct., 1921	130	26.4	159	198	32.8
Orlando, Fla.	91,800	Sept., 1922	510	18.0	180	198	19.8
Ironwood, Mich.							
Main Station	29,155	July, 1920	65	44.8	269	198	33.0
Sub Stations	9,644	July, 1920	7.5	64.2	269	198	47.6
Manistique, Mich.	71,379	Sept., 1921	140	51.0	156	198	65.0
LaCrosse, Wis.	50,834	Nov., 1912	484	10.5	100	198	20.8
Prairie du Chien, Wis.	21,017	Sept., 1921	77.8	27.0	156	198	34.3
AUXILIARY BUILDINGS—							
Des Moines Garage	51,027	May, 1922	390	13.1	160	198	16.2
Des Moines Warehouse	18,754	May, 1922	111	16.8	160	198	21.0
Des Moines Cottages 3 Cottages, 4 Fam. 22 Rooms	20,430	May, 1922	18	29.2	160	198	36.0
Ironwood Cottages 2 Cottages, 2 Fam. 12 Rooms	16,900	July, 1920	16	44.5	269	198	33.0

* Building materials U. S. Dept. of Labor.
— Each building where more than one—Contents based on outside measurements footing to average roof.
** As of Date April 1, 1923.

heating are considered to vary directly with cubic contents.

Upon the above basis the cost per cubic foot of an ordinary pumping station is decreased about 14 per cent in doubling its contents and it is increased about 13 per cent when its contents are cut in half.

It has been noted that the cost of box type reinforced concrete reservoirs follows closely the cost of moderate priced buildings.

Architectural Co-operation

It would be well if all engineers would utilize the services of an architect in the planning of conspicuous engineering works. A good architect possesses a knowledge of orderly arrangement, and the selection and grouping of materials, not possessed by most engineers. On many classes of structure the architect should be and is the master builder, and the engineer is properly a subordinate. Upon such special structures as water works buildings, the engineer must be the master builder, but he is wise if he fully utilizes the services of one skilled in architectural design. This must be done by co-operation; the engineering plans should be worked out together, step by step, as a unit.

The water works manager should not ignore public approval relating to his work and his plant. Self-respect engenders respect from others. Capable operators say that employes take better care of their machinery and are more contented when working in attractive surroundings. A good plant is an important element of good service. The time has come when water works designers can safely plan for the future and build for permanence.

The foregoing is from a paper presented by Mr. Burdick at the recent annual meeting of the American Water Works Association.

PROGRESS IN MUNICIPAL PLAYGROUND AND RECREATION ACTIVITIES

By Mabel Travis Wood, Playground and Recreation Association of America, 315 Fourth Ave., New York, N. Y.

Last year cities in the United States gave more money and thought to public play than ever before, as is shown by the Year Book statistics of the Playground and Recreation Association of America. The 1922 expenditures for playground and recreation purposes listed by 472 of the 505 cities sending reports complete enough for publication totalled $9,317,048.79, an increase of nearly half a million dollars over the amount reported in 1921.

A few years ago a city considered itself progressive if it gave its children a summer playground. Now 215 cities make the provision of supervised recreation for young and old their year-round job, and consider their play facilities as important an asset as good roads and proper sanitation. A comparison of 1921 and 1922 reports shows that during the later year 90 more recreation centers were maintained under paid leadership the year round, 169 cities reporting a total of 895 such centers. There was also a substantial increase in the number of summer centers, 2,624 being reported by 417 in 1921 and 2,834 by 416 cities in 1922.

From its beginning the recreation movement has emphasized the importance of securing trained leadership. Experience has proven that one playground under direction is worth more than two where children play at random. Particularly encouraging, then, is a 30 per cent gain during 1922 in the number of trained play directors employed the year round. This number reached 2,026, while the total number of paid workers, including those employed on part time, was 10,867. Many cities are conducting classes to train workers in play direction. Forty-seven cities reported an enrollment of 2,143 students in training classes for paid workers, and of 70 cities having classes for training volunteer workers, 39 reported an enrollment of 1,440.

There has been an increase in facilities as well as in leadership. New swimming pools, tennis courts, athletic fields and municipal summer camps have played their part in the 1922 recreation progress. Thirty-five cities reported gifts of playground sites by public-spirited citizens. The value of only 15 of these was announced, but this amounted to $611,400. One hundred and eighty cities now report swimming pools, as contrasted with 122 in 1921. The following figures show how cities are making up to the modern youngster—and his parents, too—the delights of the "old swimmin' hole" of yesteryear.

	Cities Reporting.	Total.
Swimming pools	180	465
Public baths	101	398
Bathing beaches	127	223

Two hundred and eighty-six community buildings used exclusively for rec-

reation purposes are now maintained by 111 cities. Fifty-two cities stated the value of their community buildings, the total being $8,595,548.

In districts where cities have not yet been able to supply playgrounds, they are safeguarding street play by closing streets at stated hours and providing play leaders. That street play receives more attention each year is proven by these Year Book statistics:

	1922	1921	1920
Cities reporting streets closed for play	53	38	29
Cities reporting streets closed for play under leadership	36	25	17
Cities reporting streets closed for coasting	131	98	96

One of the outstanding values of playground work during 1922 has been its effect upon juvenile delinquency. Not only does money spent for wholesome recreation lower expenditures for juvenile courts and reformatories, but it builds constructive citizenship. In St. Louis, a decrease of 75 per cent in the number of juvenile court cases was reported in a single district after the establishment of a playground. Since the Recreation Commission of Passaic, New Jersey, opened a recreation hall where 68 basket-ball teams have their games, the juvenile judge is seriously considering closing his court. The boys are so busy at play that they have no time to get into mischief. In Yakima, Washington, juvenile delinquency was reduced 50 per cent after the establishment of a recreation program by a local Community Service committee. Through an athletic club a gang of boys well known to the court became a force for better citizenship, putting up street signs, organizing a night school and working with the judge to help other boys go straight.

The sources of support of the recreation work in the 505 cities reporting to the Year Book were listed as follows:

Municipal funds	238
Private funds	140
Municipal and private funds	118
County funds	7
State, municipal and private funds	2

During 1922 18 cities, including Oxnard, California, Kansas City, Kansas, Holyoke, Massachusetts, Roselle, New Jersey, Winston-Salem, North Carolina, and Scranton, Pennsylvania, voted bond issues for recreation purposes to the total of $1,155,180.

Statistics on the number of people who daily enjoyed public play activities last year prove that money spent for this purpose was very economically administered. A dollar spent for recreation seems to go at least as far as a dollar spent for any other civic purpose. Commenting upon the economy of supervised recreation and urging wider play expenditures for 1923, the Playground and Recreation Association of America points out that the United States spends for tobacco, candy, chewing gum, soft drinks and theater admissions over $9,400,000 daily, which is more than the expenditure for public recreation by 472 cities during the entire year of 1922. The per capita cost for these luxuries is $32, while the per capita cost for public recreation, a recognized necessity, is 9 cts.

REPORT OF COMMITTEE ON SALARIES OF ENGINEERS IN PUBLIC SERVICE

(Editor's Note—Following is the full text of the report of the Committee on Salaries of Engineers in Public Service of the American Association of Engineers as presented at the recent annual convention of the Association at Norfolk, Va. The editor of this magazine, who was Chairman of the Committee, wrote the report. Constructive criticism of the report is invited.)

The Committee on Salaries of Engineers in Public Service has been trying to work out a program of activities which, if carried on over a period of years, will increase the salaries of these engineers and improve their working conditions.

The committee submitted a progress report to the Board of Directors at its meeting on Sept. 29-30, 1922, which was approved and commended by the Board. The progress report was further elaborated in an article published on pages 9 and 10 of "Professional Engineer" for December, 1922. This article, outlining a program of suggested activities, has been the basis of correspondence between the chairman and the active members of the committee. The present report is the net of these studies to date. The tentative conclusions of the committee are presented herewith with comment on each item in the recommended program.

1. The members all agree that the Association should re-affirm its faith in the fairness and efficacy of the salary schedules it has already adopted. These schedules are based on a classification of engineering positions of varying responsibility. It is possible that this classification could be improved and varied to

suit local and general living costs, but it is felt that if we could place all public engineering offices on these schedules, the condition of engineers would be much improved. So far as possible it is desirable, also, to standardize the titles and duties of engineers in public service.

2. Copies of these schedules should be placed, as recommendations, in the hands of all local authorities who have a voice in fixing the compensation of engineers. The cost of this would be negligible in comparison with the benefits. Random distribution would be of much less value than distribution timed to reach a particular locality so as to synchronize with the efforts of the local engineers in their own behalf.

3. The tenure of office, in general, is short and insecure and this affects both the public and the engineer adversely. Engineers should seek the co-operation of other employes in impressing upon the public the wisdom of establishing a permanent staff in every governmental organization, showing the increase of efficiency with experience, and the value of a staff familiar with problems that carry forward from one political administration to another.

4. Sentiment in the committee is divided as to the wisdom of placing engineers in public service under civil service regulations; some are strongly in favor of the proposal and some are strongly opposed. All agree that the subject is worthy of further detailed study and specific recommendation.

5. Local publicity given to the best work of the engineer brings him to the favorable attention of his public and enhances his opportunity to secure adequate compensation.

6. Statutes and ordinances that fix salaries can be, and frequently are, amended. Engineers should seek advances openly through amendment, just as they would go about amending existing statues and ordinances for any other purpose. If they want increased compensation they must work for it, and apply their energies at the point where relief can be secured. Where possible the Association should assist in local compensation matters and chapters and clubs should feel that some bureau, committee or individual is ready to respond when a local opportunity arises to adjust compensation.

7. Engineers in public service should favor the employment of as few men as are able to do the work properly. When it is necessary to economize, because of decrease in work or for other reasons, it is much better to lay off unnecessary employes and possibly increase the duties of the remaining employes, rather than to keep them all at reduced compensation.

8. All chief engineers should be alert in the interests of their subordinates, advancing their salaries if and when they can. This will react in favor of the chief as he is bound to benefit from an improved rating of engineers. In large organizations of technical employes, department associations and a close relationship of all members from chief to rodman are recommended.

9. The Association should continue to favor the state licensing of engineers so as to place professional engineering on a higher plan, to gain recognition from the general public and public officials, to keep the profession free from incompetents and unworthy practitioners, and to safeguard public safety, health and welfare.

10. The committee is not in full agreement as to the wisdom and propriety, on theoretical grounds, of the engineer carrying one or more sidelines, whether commercial or professional. The majority oppose this practice, as an academic proposition, but concede that with salaries as they are at present the public service engineer must sometimes do outside work in order to make ends meet. Sidelines have undoubtedly made it possible for many engineers to remain in the public service and until such time as salaries are adequate the Association should not discourage the man who seeks an income in addition to his regular salary, provided always that he can do so without slighting his regular occupation. There is small danger of excessive development in this direction as municipal administrations are, as a rule, jealous of the employes' time and it is seldom feasible, in practice, to develop a sideline to excess.

11. The desire for formal advertising of the money-saving value of good engineering, and of the nature of the service rendered the public by the professional engineer, is growing rapidly. This is a matter of primary importance to all engineers including, of course, engineers in public service.

Reference is here made, not to publicity stories and news items, but to paid advertising in some popular magazine of very large circulation.

One member of the committee has stated the case for advertising so well that his observations are quoted herewith: "The man in the other professions renders his service to his client direct; his efforts are known and appreciated by the ultimate consumer, the public. The services of the engineer largely combine with the services of others and with raw material into a finished product which becomes the object of barter and in which product the brain service of the engineer is lost to view. How then shall the public be made to appreciate the service rendered by the trained engineer? The answer is by advertising. Not the kind of advertising we associate with a new breakfast food or a brand of soap, but dignified advertising emphasizing the value of trained engineering service, the service that results not only in added safety and convenience to the public, but also in economic savings." Another member of the committee says there is "a gross ignorance, not so much of the responsibilities the engineer carries, but of the difference in results possible from good engineering as compared to no engineering, or poor engineering. In other words, the public is inclined to think that engineering is standardized and that a given piece of construction designed and carried out by this engineer, or that engineer, will produce the same result at the same cost."

Since millions of the most influential people can be reached through a single medium and be thereby made familiar with the essential nature of the engineer's work and with its great economic value to the public, it seems an easy decision to reach that the Association should set about the formulating and financing of such an advertising program. The effect of such an enterprise on the morale of the whole profession, as well as on the members of the Association, would be electric. It would dwarf anything ever undertaken by engineers in the service of the profession and the public.

In conclusion it is well to point out that just as long as engineers will work for their present small salaries the public is not going to worry at all about what the engineer thinks of the inadequacy of these salaries. The engineer need not delude himself that his sacrifices are appreciated by anybody but his family and himself, for they are not. The attitude of the public is, in the first instance, one of supreme indifference as to the engineer's compensation. This will always be true as the public is made up of individuals who are hustling for a livelihood in one way or another, and who haven't time to worry about any underpaid professional class. When, in the second instance, the public learns of the engineer's discontent these questions immediately are raised: "He knew what the job paid before he asked for it. If he didn't like the pay why did he ask for the job? If the pay is so poor why do so many seek these jobs?" The engineer's eternal hope for an increase, based on recognition of the true value of his services, as well as his more or less unselfish desire to render a public service, alike are unknown to the desperately busy and preoccupied public.

Intensive local activities, sincere cooperation between all the grades of the profession, all projected against a background of national publicity on the true nature and value of professional engineering, as herein suggested, will bring the results the engineer so long has sought.

THE AIRPLANE PHOTOGRAPH AN AID TO CITY PLANNING

City planners, commercial clubs and any number of private business enterprises are calling upon the aerial camera men for photographic maps, in verticals and bird's-eye-view obliques, says Charles Phelps Cushing, writing in Colliers, The National Weekly, for June 16, 1923. Mr. Cushing's article continues:

Kansas City, Mo.

In Kansas City, Mo., an airplane camera man on orders from a city planning commission, has been shooting a set of verticals that cover a territory of 60 square miles—the entire area of the city west of the Kaw River.

Day after day for three weeks he soared over the business section and suburbs, at a height of 7,200 ft. about the hilltops, and through a hole cut in the bottom of his plane snapped 670 plates. When the prints taken from these were trimmed and fitted together they made up a photograph of Kansas City half as big as the side of a box car. There, 600 ft. to an inch, was a detailed picture of this city where 325,000 people dwell, a picture complete to every house and tree and even antlike motor cars crawling along the streets.

Today the city planning commissioners

meet and draw up their chairs before a photograph almost as large as the wall of the room in which they gather to confer. "Where should ground be cleared downtown for the new civic center?" A committeeman who has an idea in answer to that question can arise and place his finger upon the exact spot. He can argue from an accurate, up-to-date, actual photograph of the conditions there, and no one present can fail to understand precisely what he is talking about. "Where is a new East Side boulevard connection needed?" Right here, perhaps. Or, "Where does the swift residental growth of the South Side now demand another small park for a recreation spot?" Visual evidence, facts disclosed by the photograph, answer such questions best. The commissioners not only can consult that air map as their aid in present need; they also have for their files a historical record of priceless worth to the future. A costly portrait, true. The photographer's bill ran to upward of $8,000—but money ungrudged because it was spent in a good cause, that of making Kansas City a better and better place to live in.

Newark, N. J.

Another municipality which has successfully used the air snap-shot, an eastern city which western towns often pay the compliment of claiming it shows kinship to the western spirit, is Newark, N. J. There the aerial camera man's customer was the Department of Streets and Public Improvements. One of this board's particular problems was to decide where to cut through a traffic connection downtown to relieve street congestion near a market place. The air map, one of the committeemen reported later, helped to solve a puzzle which no amount of statistics on traffic, or detailed reports from the building commissioner, or blue prints from the surveyor's office, could have cleared up so easily and quickly.

The list of American cities that have been photographed both in oblique and vertical is short. Add the downtown section of Hartford, Conn., and Manhattan Island (the business borough of New York City) and you complete it. The mapping of Manhattan Island was not commissioned by an official order; but officials have, none the less, found it of value for reference. Health officers and fire department officials have pored over these prints studying housing conditions; and traffic cops have found the actual photographs of the volume and the distribution of traffic in Fifth Avenue and Broadway a source of valuable information.

Surburban New York

The environs of New York, photographed in high obliques from elevations of 8,000 to 15,000 ft., have been taken on the order of a commission which is studying surburban planning and transit-line developments. In these high-flying bird's eyes the lay of the land is shown with much unnecessary detail eliminated. In these, visualized so that the whole situation can be taken in at a glance, are shown the towns, residental developments, transit lines and highways, congested spots and waste lands; and a prophetic eye can mark indications of the direction of future growth.

Though the airplane photograph is not yet widely used in this country by public officials, it already is well recognized as a new aid in city planning. We are far behind France, at present, in making it of public service; in France, since the war, more than 300 towns and cities have been mapped, including Paris, whose airplane portrait in verticals was made at a cost of 2,000,000 francs.

Semi-official use of airplane snapshots in the United States——if you class commercial clubs as semi-official—has been more extensive. A score or more of these clubs have made effective use of obliques for city advertising and booklet publicity.

But the greatest use of the aerial photograph in our country today is by private business enterprise. In this field we far outstrip the French.

One of the first of such commercial uses in publicity was by a constructor of big office buildings in New York City, who printed air snapshots of business sections of Manhattan Island to show at a glance what a large proportion of the city's famous skyscrapers have been erected by his firm.

One of the largest New York hotels early found that an airplane snapshot was the only sort of view that could do real justice to the hotel's size and situation, and show vividly the advantages of the location for handiness to the shopping district, the theaters, and the railway terminals.

Similar views are now being used by a glass manufacturer to furnish visual evidence of the vast amount of glass that a big city buys; and by a cement products association, which contends (and

with justice) that the public does not half understand how varied and extensive are the modern uses of cement.

Doubtless you have noticed, too, in recent advertising, that many factories are seizing upon the aerial bird's eye to show their customers what the trade describes as the plant behind the product.

Such close-ups from above—the camera man calls them character studies—are gaining great popularity with city real estate men, for they visualize to the customer in a flash the location of buildings and transit lines, industrial sites, both actual and potential, transit lines and switch tracks, highways, and even the amount of traffic in the streets.

To the promoter of surburban residential developments the airplane snap-shot is equally useful. It shows the streets, the parks, and boulevards, the amount of construction, in process and completed, and the character of it all, the foliage, the street car lines, the location of schools and churches and shops, and the entire lay of the land, to every hole and hazard of the golf links. A suburban real estate man in Kansas City, who was one of the first to have his properties photographed from the air, makes this further observation on the worth of the idea:

"You learn a lot from it yourself, too. You see not only what you have, but for what you need to plan. If he has vision, a real estate man can discover a city from the air. With an airplane view to help him visualize the situation he can glimpse a city of the future and plan for ten years or twenty or a generation ahead."

REDUCING RAILROAD - HIGHWAY CROSSING ACCIDENTS.

By H. A. Rowe, Claims Attorney, Delaware, Lackawanna and Western Railroad Co., 90 West Street, New York, N. Y.

The American Railway Association has determined upon a renewal this year of the activities of its Safety Section for the prevention or reduction of railroad-highway crossing accidents and its plans will shortly be in effect.

During the past 25 years there has grown up within our country an industry almost unparalleled for the rapidity and extent of its development. From practically a zero point in 1898, the automotive industry has advanced to a production of 2,576,000 autos and trucks in the year just past. On Dec. 31, 1922, there were actually registered within continental United States 12,357,376 automobiles, or the equivalent of one auto to every 8.7 persons throughout the country and the end is not yet.

In 1898, there were 657 deaths at railroad highway crossings and in 1917, the peak was attained when 1,969 deaths occurred at such crossings. Injuries have grown from 1,123 in 1898, to 5,383 in 1922.

The Interstate Commerce Commission in its report for 1922, states there were 1,810 persons killed and 5,383 injured in 1922, at such crossings.

During the five years ending Dec. 31, 1921, there were 9,101 persons killed and 24,208 injured at railroad highway crossings. These figures are sufficient to indicate the serious increase of such deaths and injuries and to impress upon us the need for action toward their curtailment.

The necessity for their prevention or reduction appeals to us from several angles.

Humanity

First. That of humanity. Who of us can escape the pangs of regret when we read or hear of those who have been unnecessarily sacrificed in such mishaps, or can escape the sympathetic touching of our heartstrings when we dwell upon the thought of the pain, the suffering, and the mutilation borne by those who may survive, but pay a substantial penalty for someone's carelessness. For humanity's sake alone, all well disposed men should lend their very best efforts to a diminution of the risk, if such diminution can be pointed out.

Public Duty

Second. That of public duty. As citizens, cognizant of our duties to each other, it behooves us to demand competency and care from auto drivers equal to that which we demand from engine drivers. Any lessening of this standard is a winking at the incapable and reckless auto driver.

Pride

Third. That of pride. Consider the injury to the pride of these highminded, capable railroad executives whose ambition it is to not only conduct their roads efficiently but with a deep satisfaction in the safety of travelers upon their railroads. It can not be said that railroad executives are unmindful of the injury and death to travelers over the high-

way, but it can be freely admitted that their solicitation for the safety of the passengers upon their trains is a paramount care, and because of the frequency of train derailments arising from highway crossing accidents, an additional alarm is felt.

Cost

Fourth. That of cost. I did not mention this first, because I know from experience that railroad executives are actuated by a higher motive than the avoidance of the payment of money, notwithstanding the fact that practically all crossing accidents in certain states are simply an assessment of damage by juries.

There are several ways to grapple the problem of highway crossing accident prevention: (1) by engineering; (2) by education; (3) by legal process.

Let us consider them:

By Engineering

On the 31st day of December, 1921, there were 252,022 grade level crossings over class 1 railroads operating within the United States, after deducting 485 crossings which were eliminated that year.

The elimination of the crossing by separation of grades is the absolute solution of the problem. In considering it, however, we are instantly confronted with two elements which are insurmountable.

The element of Time. Aa the rate which crossings have been eliminated in the last five years, it will take about 600 years to remove them and though the matter of elimination be speeded tremendously, yet we are safe in saying that generations of time are involved in their ultimate removal.

It is proper that crossings in densely congested areas be first selected for elimination, but the futility of expecting much from such elimination arises when we recognize that most of our crossing accidents occur in rural communities, frequently where the view of the traveler upon the highway is most excellent.

The element of Cost. The question of cost makes elimination by separation of grades prohibitive. Competent engineers say that taking the crossings of our country by and large, a reasonable estimate of the cost of removal in rural and urban districts would approximate not less than $50,000 per crossing. (Upon the road I have the honor to represent, an estimate of $50,000 for the removal of a certain crossing was made before the war. We are not engaged upon the work of that removal and its cost this year will be nearer to $125,000.)

Simple arithmetic then tells us that the cost of elimination by separation of grades is in excess of $12,500,000,000, practically all of which would be non-revenue producing and impossible of obtainment.

Enginering, however, embraces other details than elimination, such for instance, as the establishment of highways parallel to the railroad instead of permitting the crossing and recrossing of the track by the same highway. In this manner many crossings can be eliminated with a minimum of expense. Island turnouts are in use upon some highways requiring the driver to deliberately turn at a right angle and then to the left, thus affording opportunity for observation from both angles before passing over a railroad track. This is suited to specific situations only.

Engineering also includes the removal of unnecessary obstructions to view; the maintenance of present crossings in good order for travel; the construction and operation of mechanical barriers, such as standard, flexible and rigid crossing gates, and various forms of visual and audible signals including automatic flagmen.

Railroads should not cease their study and adoption of warning devices until perfection is reached and should bear particularly in mind the increasing development of enclosed cars making audible signals of lesser value than formerly. In the winter season, with the windows of an enclosed car up, safety is dependent almost exclusively upon the single sense of sight.

We may also include under the general heading of engineering the proper equipment of motive power with efficient and legal whistle, bell and headlight. The installation of these means of warning are of no avail, however, unless employes are properly trained in their use and carefully watched, checked and disciplined for every deviation from effective warning.

Crossing watchmen must be selected for their physical and mental qualifications, and harsh though it may seem, the halt, maimed, decrepit and mentally unqualified crossing flagman must be removed and replaced with competent successors, or automatic devices.

By Education

It is believed that in the education of the auto driver to the exercise of the highest degree of care and the insistent demand on the part of his passengers, whether paid passengers or guests, that he no longer gamble with their lives but appreciate fully his moral and legal responsibility for those in the car with him, we have put our finger upon the spot where the immediate remedy rests and it is to education that the Committee on Prevention of Highway Crossing Accidents, Safety Section, American Railway Association is addressing its efforts.

Many are familiar with the campaign which the American Railway Association conducted last year by posterizing almost every community in our country; securing the support of the President of the United States; of national, state and civic officers and organizations, the press, and the motion picture industry of our country.

This was the beginning of our task, and while the results in figures did not prove that a single effort could be made and mishaps stopped, yet there was substantial encouragement that we are on the right track, even though the end of the road be far beyond our horizon.

During the four months of the 1922 campaign 758 persons were killed at highway crossings, compared with 685 in 1921, an increase of 73. However, 61 of the 73 occurred in the month of June, before the campaign was making itself felt. There was an increase of only 12 in the last three months of the campaign. This indicates unmistakably that the public is amenable to direction towards its own safety.

This year we shall tackle this problem with new vigor, having developed a poster vastly superior to our original, profiting in this, and in other respects, by the experience gained. We have sacrificed all reference to a campaign, to any period of time, and to the American Railway Association, in the firm belief that with these things omitted, the public will more readily grasp the situation as being its problem and realize that it must pull its own chestnuts out of the fire. It is believed that approximately two millions of these posters will be distributed throughout our country. There will be a replica of the poster as a windshield stickers upon automobiles. Last year we used a correspondence sticker for railroad mail, and it will be continued this year.

A new feature is the use of a postal card inviting membership into a Careful Crossing Club. Undoubtedly a substantial use will be made of this feature. The co-operation of the moving picture industry has again been proffered, both in the use of slides which are duplicates of this year's poster, and of a secondary poster which will be used for variation, as well as the display of a series of pictures showing preventable accidents.

Arrangements have been made for the teaching of safety at crossings by means of the motion picture in standard films and without referring to the purpose which is being accomplished. A series of bulletin boards have been arranged for, to be placed away from railroad tracks and bearing a replica of the poster very much enlarged. Electrotypes and matrices of the poster will be freely used by local newspapers. The Automobile Blue Book will carry our slogan as a caution at railroad intersections and arrangements have been made with the road-map publishers emphasizing the need of care at crossings.

Suggested Resolution

Influential organizations have been requested formally to pass the following resolution:

WHEREAS, it is recognized that the number of automobiles using our public highways is constantly increasing and has created hazards of travel beyond those of former years, and indications point to an increased growth in the use of such highways. And

WHEREAS, Our public highways traverse and cross the tracks of steam railroads throughout the country at grade level, there being over a quarter of a million railroad-highway crossings, and because of the enormous expense and generations of time involved in the ultimate removal of such railroad-highway crossings. And

WHEREAS, The number of serious and fatal injuries arising out of accidents at such railroad-highway crossings is becoming a matter of public concern. Therefore be it

RESOLVED: That the.....
.....place itself on record as approving the efforts of the American Railway Association to encourage travelers upon the highway,

particularly those using automobiles, to exercise a high degree of care at railroad-highway intersections, and this body urges upon its membership wholehearted personal co-operation in discouraging reckless disregard of danger at such crossings.

Safety Regulations at Railroad Grade Crossings

Inasmuch as our highways are in such common use today, serious effort should be made to enact and enforce as nearly as possible uniform highway traffic laws. Simplicity should be the dominant feature of such laws to afford a fuller understanding. It must be recognized that the present use of the highway presents entirely different aspects from the period when most of our laws were established and that progress must be accepted by and demanded from the state, the railroads and the users of the highway.

It should be the duty of state, county and local officials to construct highways *parallel* to railroad tracks where there is a frequent crossing and recrossing of the same highway within a limited area.

The highway approach to railroad crossings should be established within a moderate maximum grade and be maintained in excellent order.

The construction or development of barriers to view, at or near railroad crossings should be prohibited.

It should be obligatory on the part of the road authorities to compel the removal of unnecessary barriers to view, adjacent to a railroad crossing.

There should be established at uniform distances a standard sign along the highway indicating the approach to a railroad crossing.

It should be forbidden to mutilate, alter or change a railroad crossing sign or approach sign, or to simulate or represent any such sign for commercial purposes.

Commercial advertising of every character should be absolutely forbidden between the advance sign along the highway and the railroad track.

There should be a standard and uniform sign solely to indicate a railroad crossing and wherever possible one post should contain all indications at crossings for simplification.

At every crossing where the view is restricted by immovable barriers there should be an automatic warning device.

Wherever practical, railroads should seriously consider the substitution of automatic warning devices in place of manual protection. Automatic devices are on duty 24 hours of the day, are less affected by failures, and offer positive opportunity of proof that warning was given.

Serious attention should be paid to the suggestion that all highways crossing railroad tracks at grade, whether protected or otherwise, should be plainly marked with three distinctive lateral lines indicating that tracks are 200 ft., 100 ft. and 25 ft. distant, respectively.

Licensing officers should exercise increasing care in granting licenses only to those physically and mentally qualified. Minimum eye and ear standards should be established. A certificate of a responsible opthalmologist and aurist should accompany application for license.

Authorities having the power to issue licenses to drivers should be empowered and required to revoke such licenses and deny renewal for substantial period in cases of driving while intoxicated, recklessness, incompetency or defiance of local regulations or frequency of mishaps.

State licensing authorities should be empowered to require a report from a driver covering every automobile accident within the state. Failure to report within ten days should automatically revoke license. Repeated collisions with crossing gates or subjecting flagmen to unnecessary hazards should be sufficient cause for revocation.

Driving while under the influence of liquor or drugs or grossly reckless driving should be a criminal offense and subject to jail sentence instead of fine.

It should be illegal to drive a car over a railroad track at a higher rate of speed than ten miles per hour, and there should be established a sufficient police force in every community to make this rule effective.

Require state, county or municipal authorities to provide police traffic regulation at all railroad crossings traversed by more than 250 vehicles within 24 hour period.

Require automobiles carrying freight or passengers for hire to come to a full stop between 25 and 75 ft. from railroad crossings and not to proceed until the way is known to be clear. This can be made effective by rewards upon conviction.

Automobiles should be required to have ample braking power and the braking devices and equipment should be periodically inspected and reported to the licensing officer. There should be substantial

punishment for both driven and owner of automobile in mishaps due to brake failures.

Require prosecuting attorneys to endeavor to enforce the statutes against manslaughter as against drivers of cars responsible for the death of passengers in automobiles or trains.

It should be made impossible for the owner of a vehicle to protect himself by insurance for the first $100 loss or damage in public liability cases. The reliance upon an insurance carrier to pay minor damages tends to indifference and lack of care.

These suggestions are simply skimming the surface of our needs and are not intended to be the result of exhaustive study. They are offered for what they are worth in the sincere hope that something of value may be contained therein to assist in checking the human and economic wastage at crossings and at the same time make the way clearer and safer for those who properly should enjoy the pleasures afforded by our modern means of transportation. We wage no war upon the automobile (most of us are interested as owners). On the contrary, we are exerting ourselves to free it from the stigma of a slaughtering agency when operated by the criminally reckless or heedless. There is an excellent opportunity before all public authorities charged with the construction, maintenance and control of traffic on highways and those interested in the operation of vehicles over our highways, to co-operate practically and sincerely in the laudable effort to check the increase of railroad-highway crossing accidents and there will be abundant gratification for all in the saving of human suffering and no one will be loser by his co-operation.

The foregoing is a report by Mr. Rowe to the recent annual meeting of the National Highway Traffic Association.

PROFITABLE SALE OF EXHAUST STEAM FOR MUNICIPAL HEATING AT MILES CITY, MONT.

A few years ago Miles City, Montana, erected a new city hall and fire station within a block of its water and electric station. It was decided that instead of installing an individual boiler in the new building they would install some underground heating pipes and heat the building by means of the exhaust steam from the electric station. Accordingly about 600 ft. of underground piping was installed and the building was satisfactorily heated without the use of live steam and with no perceptible back pressure.

The first adventure being successful, and the business men desiring the service, it was decided a year later to serve the business section of the city with heat. Accordingly plans and specifications were drawn for the underground piping system and contracts were let. With materials on the ground the city was stopped from proceeding with the work by an injunction secured by one of the property owners who claimed that the city was without authority to enter into a general heating business. It was argued in the courts and decisions rendered by the Supreme Court of the state that the city had a right to enter any business that an individual could, providing such business did not become a burden upon others than those directly benefited. It was later shown in court that the city was losing more than $100 per day by not selling the exhaust steam from the electric station and the jury decided that the city should proceed with its plan.

Development of System

Installation of approximately 1,800 ft. of underground mains was completed during 1912, and in 1917 about 1,600 ft. more were added. At the end of the year 1917, the underground system consisted of 3,953 ft. of mains varying in size from 14 ins. to 6 ins. and 2,154 ft. of services ranging from 4 ins. to 2 ins. Forty-seven buildings containing 4,656,300 cu. ft. of space and 65,139 sq. ft. of radiation were heated. The original cost of the distribution system was $42,508.

At no time during the history of this plant has exhaust steam been considered without a value to the electric department. Many cities have considered exhaust steam a waste and without value, allowing the heating department the use of such steam without paying the electric department for the steam.

Operating Figures

Quoting from the report of the superintendent, J. J. McGill, for the year ending Dec. 31, 1917:

Investment in heating department	$42,508.10
Gross Revenue	16,708.00
Labor and maintenance	561.60
Exhaust steam at 25c per 1,000 lbs., 37,691,000 lbs. (33,137,000 lbs. sold)	9,422.50

Depreciation, 5 percent	2,125.40
Total Expense	$12,109.50
Net Income	4,598.50
or 10.8 percent on investment	
Credit to electric department	9,422.50
Total Earnings to City	$14,021.00
or 33 percent on investment	

That same year the public service commission's report showed an earning of 34.5 per cent on the heating investment. This was due to the fact that the public service commission made no charge for exhaust steam, considering it a by-product without value. This basis is erroneous, for the back-pressure on engines does slightly reduce the efficiency of engines and causes an increase in operation directly chargeable to the heating department.

The utilities of Miles City maintained their old rates in face of advances of operating cost as long as they could without detriment to service and operating results. But like all utilities they found it necessary to increase rates during 1920, and accordingly petitioned the public service commission for increases. Such increases were granted and went into effect Nov. 1, 1920.

The rates in force as of Jan. 1, 1920, were as follows:

Heating

Condensation Per Month	Rate Per 1,000 Lbs.
1st 10,000 lbs.	$0.90
Next 10,000 lbs.	.76
Next 10,000 lbs.	.73
Next 10,000 lbs.	.69
Next 10,000 lbs.	.62
All over 50,000 lbs.	.55

Minimum bill $5 per month.
Discount, 20 percent if paid before 25th

Electric Rate—Lighting

Current Used Per Month	Rate Per K. W.
1st 50 K. W.	$0.10
Next 50 K. W.	.09
Next 200 K. W.	.08
Next 200 K. W.	.07
Next 500 K. W.	.06
All over 1,000 K. W.	.04

Minimum bill, $1 net.
Discount, 10 percent if paid before 25th

Power Rate

Current Used Per Month	Rate Per K. W.
1st 100 K. W.	$0.05
Next 100 K. W.	.04½
Next 200 K. W.	.04
Next 200 K. W.	.03½
Next 200 K. W.	.03
Next 200 K. W.	.02
All over 1,000 K. W.	.01½

Special rate of 1c per K. W. for pumping city water.

This charge is made in order to separate the water and electric departments.

Minimum Rate on 1 H. P. or less, $1.50 per month.

Minimum Rate on 2 H. P. or over, $1 per month.

Country Lighting on 6600-Volt Line

Current Used Per Month	Rate Per K. W.
1st 10 K. W.	$0.12
Next 40 K. W.	.10
Next 50 K. W.	.09
Next 200 K. W.	.08
Next 200 K. W.	.07
All over 500 K. W.	.06

Minimum bill per month, $1.50 net.
Discount, 10 percent if paid before 25th.

These rates were increased as of Nov. 1, 1920, as follows:

Heating

Condensation Per Month	Rate Per 1,000 Lbs.
1st 10,000 lbs.	$1.20
Next 10,000 lbs.	1.10
Next 10,000 lbs.	.90
Next 20,000 lbs.	.80
Over 50,000 lbs.	.70

Minimum bill, $5 per month net.

Rate based on $4 per ton Montana coal delivered at plant.

Whenever the cost of coal so delivered is more or less than $4 per ton, an addition or reduction, as the case may be, will be made to the rate of 2c per 1,000 lbs. condensation for every 10c or major fraction thereof in the cost of coal.

Electric Rates—Lighting

Current Used Per Month	Rate Per K. W.
1st 50 K. W.	$0.12
Next 50 K. W.	.11
Next 200 K. W.	.10
Next 200 K. W.	.09
Next 500 K. W.	.07
Over 1,000 K. W.	.05

Minimum, $1.10 net.
Discount, 5 percent if paid before the 25th.

Power

Motors of 1 H. P. or less, $1.25 per month and motors over 1 H. P. per month per H. P. connected plus following rate:

	Rate Per K. W.
1 H. P. or less	$0.04
2 H. P. or less	.0375
3 H. P. or less	.035
5 H. P. or less	.0325
7½ H. P. or less	.03
10 H. P. or less	.0275
15 H. P. or less	.025
20 H. P. or less	.0225
25 H. P. or less	.02
35 H. P. or less	.0175
50 H. P. or less	.015
75 H. P. and over	.0125

Country Lighting

Current Used Per Month	Rate Per K. W.
1st 10 K. W.	$0.15
Next 40 K. W.	.13
Next 50 K. W.	.11
Next 200 K. W.	.09
Next 200 K. W.	.08
All over 500 K. W.	.07

Minimum, $1.50 net.
Discount, 5% if paid before 25th.

Note: The slight increase in electric rate during war prices. This is due to the credit to lighting department from heating department.

Operation of Heating Department for 1920

The operation of the heating department for the year 1920, which includes two months at the new rate is given as follows by Mr. McGill:

Investment—		
Mains, services and meters		$52,000.00
Revenue—		
Heat sales, 55,065,000 lbs.		32,449.87
Fuel for entire plant (electric and heating depts.)	$77,738.44	
Boiler room labor	19,856.00	
		97,594.44
25% of fuel and boiler room labor charged to heating department	$24,398.61	

*This item is characterized as too high by J. J. McGill, superintendent of the Light and Power Department.

General salaries and expenses (25% of total charged to heating dept.)	2,232.38*
Maintenance of meters, customers' inspection and reading meters	991.19
Replacement reserve	2,080.00
Earnings	2,747.69
	$32,449.87

Earnings on investment, 5.3%.
Earnings on investment including credit to electric department of $26,630.99, 58%.

If the present rate had been in force during the entire year the revenue would have been $38,691.69, or $6,241.82 increase, which would have produced an earning of $8,989.51, or 17.3% on investment, not considering the credit to the electric department. Note that overall earnings of heating department have increased from 33% to 58% in 1920.

It is interesting to note that Mr. McGill changed for 1920 his method allocation of station expense from that used in 1917. Formerly all steam was charged to the heating department at 25c per 1,000 lbs. The heating department is now charged with 25% of the entire fuel and labor of boiler room. This means an increase to the heating department of 57% over 1917, while the new rate to customers is but 40% increase over 1917.

Further analysis of the operation of this plant shows that if all steam were charged to the two departments on a live steam basis the heating department would be charged with 30%, instead of 25%, of the fuel and boiler room expense. Thus, when it is considered that practically all of the steam furnished the heating department was exhaust, it is believed that 25% is a fair basis for Miles City. However, with the increasing of the electric load and the heating load remaining about the same, the time will come when 25% will be unfair to the heating department.

Mr. McGill reports that in eight years his heating load increased until he heated 98% of the business adjacent to his underground system. He had many applications from outlying districts for service but realized that the revenue from such districts would not pay the interest on the investment and advised his council against such extensions.

There is no question but that our coal supply can be greatly conserved if other municipalities will adopt the same methods as are now being used at Miles City. It must be kept in mind that the fuel committees of this country and Canada laid great stress upon conserving our fuel supplies. The Canadian committee recommended central station heating plants, where greater boiler efficiency would be secured and the same amount of heating be accomplished with less coal.

HOW INDIVIDUAL ORGANIZATIONS CAN FIT THEIR WORK INTO A BROAD HIGHWAY RESEARCH PROGRAM

By Dr. W. K. Hatt, Director Advisory Board on Highway Research, National Research Council, Washington, D. C.

Immediate Work of Research

In order to determine what each can do to expedite the collection of authentic data on the basis of which highways may be wisely selected to meet the economic needs of the region, properly built to conform to the economics of the situation, and operated in the interest of the public, the immediate necessities may be outlined:

(1) Many problems in highway engineering are accompanied by corollary problems in economics of highway transport. For instance: What sum may profitably be spent in capital costs of construction to reduce a grade? The answer must depend on volume of traffic and on operating costs of road and vehicle. Again, decisions upon changing second-class into paved roads involve cost of road maintenance, tires, gasoline, and repairs and depreciation to vehicles, etc. The reduction of operating costs due to improved surfaces are large on roads of heavy traffic; how heavy? The reflex action of improved alignment on change of design of vehicle also suggests itself. Reliable data appear to be largely wanting. Research activities should be pushed.

(2) The study of methods of financing road construction, and the distribution of the expense between those benefited, awaits fact-finding surveys. The study itself needs the services of trained economists. The sources from which the tax dollar comes, and its distribution among roads, education, charities, etc., should probably be determined.

(3) Studies of the effect of highway improvements on land values are needed; and also of the effect of highway improvements upon industry and the development of typical regions, such as

truck farming or resort areas. The results of such studies will be a guide for similar areas under development.

(4) The laws governing the growth and dispersion of traffic, and the mechanics and psychology of safely handling such traffic in congested areas, need study by research methods.

(5) The purpose and methods of, and the instrumental equipment for, basic traffic surveys upon which state construction and maintenance funds may be allocated is a live issue. A simple instrument for automatically counting and weighing traffic is now under development in the Bureau of Public Roads.

(6) The large volume of valuable data, accumulated at the cost of hundreds of thousands of dollars, through studies of soil properties, effect of loads and strength of slab—data that underlie the as yet undisclosed principles of the mechanics of slab design, should be brought together and analyzed to uncover the principles of action. The instrumental equipment and technique in this field represent a remarkable advance in the science of measurement. With the mechanical principles determined, then the engineer can be given formulas for fitting the road to the load. If these principles are still hidden, final coordinated researches should be planned to settle these questions. If it is true, as it seems to be, that stiff slabs on soft subgrades should be thick at the edges and thinner at the center, what should be the proper distribution of the thickness, and how should slabs be reinforced to provide longitudinal stiffness?

(7) The economics of pavement types in specified situations must be learned from carefully gathered data, so that decisions may be made less upon ex-parte arguments and more upon exact information.

(8) The findings of laboratory tests upon materials of construction should be scrutinized in the light of experience in operation to determine to what extent these tests are predictive of service value in the road. Studies of the destructive action of alkali and sea water upon concrete structures are of interest to highway engineers.

The above problems are pressing for early solution. Research is not only of direct daily use, but is insurance.

It is not too much to say that there must be created a new realm of economic data to quiet opinionated discussion of moot questions in the field of highway transport. How can issues be settled or college courses in highway transport be established except on the basis of scientific information, gained from surveys of existing traffic and collection of data of costs of operation of road and vehicle, maintenance data, study of taxation and benefits? The end may be reached by,

(a) Evaluating the present information.

(b) Planning new researches where needed.

(c) Publishing authentic data as fast as they are accumulated.

Grouping of Organizations

During the development of highways in the past years, various voluntary organizations have arisen to meet needs and influence policies. The existing list of organizations discloses cases of duplication of effort and indefiniteness of purpose.

More recently organizations have entered the field with some official status and legislative duties, and possibilities of expansion to greater power, such as the American Association of State Highway Officials.

The following list of consistent members of the Advisory Board on Highway Research of the National Research Council represents the several fields of highway activity: American Association of State Highway Officials; American Concrete Institute; American Institute of Consulting Engineers; American Society of Civil Engineers; American Society of Mechanical Engineers; American Road Builders' Association; American Society for Municipal Improvements; American Society for Testing Materials; Associated General Contractors of America; Association of American State Geologists; Association of Land Grant Colleges; Bureau of Public Roads, U. S. Department of Agriculture; Bureau of Standards, U. S. Department of Commerce; Corps of Engineers, U. S. Army; Engineering Foundation; Eno Foundation; National Automobile Chamber of Commerce; National Highway Traffic Association; National Safety Council; Rubber Association of America; Society of Automotive Engineers; Western Society of Engineers.

If representation were had from steam railway and electric traction interests, as far as these are related to highways, the circle would be complete.

It is a difficult task to select a group of organizations signally prepared to carry on specific researches. However, the following list includes organizations operating in well defined fields, and which, taken together, fill the needs of highway research to a fairly satisfactory degree:

A. Production of Research Data

1. Research program and coordination: Advisory Board on Highway Research.

2. Mechanics and psychology of traffic signs and codes: Eno Foundation.

3. Vehicle design and operation: Society of Automotive Engineers, and Bureau of Standards.

4. Structural Design of Roads: Bureau of Public Roads, State Highway Commissions, and Universities.

5. Maintenance studies: State Highway Commissions, and Bureau of Public Roads.

6. Character and use of materials: Bureau of Public Roads, State Highway Commissions, Bureau of Standards, Universities, Industrial laboratories, and State geologists.

7. Basic traffic surveys: State Highway Commissions.

8. Highway transport studies: Bureau of Public Roads, State Highway Commissions, and Universities.

9. Economics of location, road resistance, and power requirements as affected by alignment and surface, and of operation factors: Bureau of Public Roads, State Highway Commissions, Universities, Society of Automotive Engineers, Bureau of Standards, and U. S. Army.

10. Construction plants: American Road Builders' Association, Associated General Contractors, State Highway Commissions, and American Society of Mechanical Engineers.

B. Collection of Statistics

1. Cost of transport: (a) Road: Bureau of Public Roads. (b) Vehicle: Society of Automotive Engineers, National Automobile Chamber of Commerce, and Associated General Contractors.

2. Theory of finance: Departments of Economics of Universities, Bureau of Public Roads, and State Highway Commissions.

C. Standards of Regulation and Recommended Practice

1. Methods of testing materials: American Society for Testing Materials, Association of State Highway Officials, Bureau of Standards, and Bureau of Public Roads.

2. Structures: Bureau of Public Roads, Association of State Highway Officials, and American Society of Civil Engineers.

3. Standard plans for roads and records: Bureau of Public Roads, Association of State Highway Officials, and American Road Builders' Association.

4. Use of road: Association of State Highway Officials, National Highway Traffic Association, and National Automobile Chamber of Commerce.

5. Signs and signals: Eno Foundation, American Standards Committee, Association of State Highway Officials, National Highway Traffic Association, and National Safety Council.

D. Coordination of Transportation Agencies

Bureau of Public Roads, U. S. Chamber of Commerce, National Automobile Chamber of Commerce, Interstate Commerce Commission, and Department of Commerce.

E. Education in Colleges and Common Schools

Highway Education Board, and Association of Land Grant Colleges.

A glance at the above lists of subject matter and agencies will indicate that the Bureau of Public Roads and the state highway commissions and universities are the three active agencies in the production of research data. Through the Advisory Board on Highway Research these three agencies are closely in touch with each other's work and pursue a unified purpose.

The most useful service of the Bureau of Public Roads is in fundamentals, in the discovery of broad principles and general properties, and in the development of the technique of highway research applicable to the entire country. The universities can cooperate in the research problems of the state highway commissions because their special equipment and expert staff are prepared for such service, and because they are zealous in industrial development of the states. The state highway commissions are much better prepared than are the universities for the routine business of reception tests of materials.

In the fields of vehicle design and op-

eration the chief agencies must be the Society of Automotive Engineers and the Bureau of Standards. It is increasingly evident that the highway engineer and the automotive engineer must work more closely together.

Of the 27 agencies listed, some are not directly operating in the production of research data. They deal with policies, with education, or with standards, the foundation of which, however, must be the research data. These agencies follow the general psychology of the human being, viz. an instinct for action, even the absence of information necessary for wise judgments. Indeed, in the pressing necessity for roads to discharge existing traffic, it is not to be hoped that research will ever catch up with construction and use. Indeed the need for research is only seen when use develops problems. However, we must remember that our program of highway construction is not near its peak activity, and the use of research in saving construction and operating cost has yet a wide field for application.

Function of Advisory Board on Highway Research

The large number of organizations for highway research shows real need of such an agency as the Advisory Board, first of all to determine the status of several fields of research to determine if each has been sufficiently occupied, then to plan and stimulate researches in fields that need occupying, and to coordinate the programs.

For example, during the past year a conference was called by the Advisory Board and attended by the various researches who are measuring the resistance of the road to the translation of vehicles, in order that some definition might be reached of the purpose of such experiments, and of the limits of the fields of work of the highway engineer and the automotive engineer. In this conference it appeared that the object of these experiments was to determine the rolling and air resistance to the passage of vehicles over highways of various alignments and surfaces. It also appeared that the existing data of road resistance was sufficient for the purpose.

The automotive engineer in turn should determine by laboratory tests the power characteristics of the vehicle, and the fuel, oil and grease consumption, from which the performance of the vehicle can be calculated on various surfaces and grades, and the excess power for trailers determined to a substantial accuracy.

The other operating costs of repairs, depreciation, etc., can best be determined by statistics of average costs collected for types of vehicles in regions containing homogeneous classes of roads.

Upon the assembled data the locating engineer can adjust capital expenditure to operating costs for a predicted traffic.

A suggested layout of work is as follows:

A. Research for Automotive Engineer

1. By laboratory tests to determine:

(a) Fuel, oil and grease consumption and power development of vehicle and from these to calculate the performance on various surfaces and grades, and the excess power for moving trailers. See Bulletin of Michigan State Highway Department on Experiments, by Prof. W. E. Lay.

(b) To study the effect of improved grades on the design of the power plant of the vehicle.

(c) To consider the design of the vehicle in order to impose on the road the minimum loads for specified capacity of vehicle.

(d) To study the lighting system of autos with a view to safety, and the mechanisms indicating intentions of the driver.

B. Research for Highway Engineers

1. To find rolling and air resistance of motor vehicles at various loadings and speeds on types of road surfaces and curves; limit of adhesion.

2. To determine the loads imposed on road surfaces by various vehicles, with various tire equipment at various speeds.

3. To measure the stresses and strains acting in various road surfacings under the expected loads, and the properties and improvement of subsoils, and the character and use of materials of construction.

4. To determine capital and maintenance costs resident in the road.

5. To determine the laws governing the increase of highway traffic by basic surveys of flow of traffic in typical regions.

C. Research for N. A. C. C. and Auto Associations

1. To assign schedule cards to a selected group of, say, 200 passenger drivers for each condition, to obtain operating expenses on the average for:

(a) Three classes of cars;

(b) Regional conditions: Macadam and gravel roads, Dirt roads, Paved roads.

(c) Topography: Level, and Hilly.

2. To study records of truck and pas-

senger bus fleets to obtain similar data.

D. Locating Highway Engineer

Given road resistance, power available at wheels, speeds, fuel, oil, and grease consumption, tires, repairs, driver's time, depreciation, overhead, expected traffic,

To find: Relation between capital costs of construction and operating expenses on roads of various surface and grades (length and rate).

E. Federal Agencies

1. To study movements of commodities and passengers by highway and railway in the interest of coordination of transport.

2. To study the financing of highway improvements in the light of experience and science in related fields of financing of public improvements.

3. To study the effect of highway improvements on regional industries.

4. To study the effect of highway improvements upon general productivity of men and industries.

F. Advisory Board on Highway Research

To evaluate progress in the several fields of highway research by an analysis of completed and current projects; to outline needed researches; and to assist existing organizations to correlate their work in the light of a comprehensive program; and to publish bulletins of information on methods and technique of research, and on progress in the several fields.

Through the Committee on Structural Design of the Advisory Board a conference was held of those responsible for the three major researches upon structural design of roads, at Pittsburg, California, the Bates road in Illinois, and the Bureau of Public Roads experimental work at Arlington, Virginia. At this conference the content of these researches and the apparent indications were discussed and suggestions for useful extension of the program accepted by those in charge.

Bulletin No. 21 of the National Research Council entitled "Highway Research Projects in the United States," gave the results of a survey of the various research projects now under way throughout the United States. The projects were divided both geographically and as to subject matter, and each one described in such a way that the reader might know the purpose and nature of the experiment. Such a survey serves two purposes: First, to put individual researchers into communication with each other so that the methods and instruments might be comparable; and second, so that one state might be saved the expense of seeking an answer to questions that had already been answered in the neighboring state. An additional service of the bulletin will be the indication of fruitful fields of research to those agencies who have the will to work and the means of accomplishment.

The Field of Highway Research

A broad consideration of highway research would lead to a twofold division; first, a study of materials going into the roads and the design of sections to the end that they may be mechanically fit to withstand the forces coming upon them from climate and traffic; and second, the economic data of costs of transportation, not only to permit a wise location of roads to fit the economic needs of the region, but also to serve to educate the public whose judgment must finally determine the progress of highway construction. For instance, the data obtained at the Iowa State College of the relative operating cost of traffic over dirt roads and paved roads, and the experiments at the University of Michigan, clearly show the savings to the people of the state through the paving of roads.

Nor must we narrow the field of research to the purely engineering factors of the highway problem. Theories of finance resulting from experience in other fields of public undertakings will be applicable to problems of highway finance. Commodity surveys, to determine just what use is being made of the highways, are necessary for wise judgments upon the relation of the building of highways to the transportation needs of the nation. It is these broad fields of public policy that are particularly important just now in respect to the prosecution of research.

Activity in constructing and in testing constructions runs far ahead of analysis. The gross or surface appearance of experiments is not always reliable, and it is only after the careful analysis of data of deformations from various standpoints that the underlying truths appear. A proportion of the money now spent in research could profitably be devoted to the financing of a corps of analysts who would scrutinize the marshalled data and determine the issues involved. Such an organization of analysis should be provided either for the Advisory Board on

Highway Research, or for the United States Bureau of Public Roads.

Another need is for a publication for the findings of research after the work of the analysts has been completed and the committees have met. Many valuable data and reports lie buried in the files of the state highway commissions, the industrial organizations, federal departments and universities.

I can think of no more useful service to be performed by the organization connected with highway construction than contributions to some agency for the purpose of the analysis and publication of the large volume of data now available. The subject seems important enough from the national standpoint, because the cost of highway transportation is estimated at 7 to 8 billion dollars a year, which is one-tenth of the national income. It would justify the support by some of the many foundation funds now devoted to the study of various economic and scientific problems. It is of course difficult to interest such bodies in work of this kind which seems to most persons to be only in engineering and industrial fields, and to lack that human appeal which accompanies a study of public health and the problems of government. Various organizations have live contact with potential sources of support of such an agency. It apparently needs only a group of individuals who will arrange that the work of the Advisory Board on Highway Research will be adequately financed for a period of five years. In this way the acknowledged potentialities for useful service of our committee will be realized and the collection of data and analysis be expedited in the interest of highway development.

The foregoing paper by Dr. Hatt was presented at the recent annual meeting of the American Road Builders' Association.

STANDARD HIGHWAY DANGER SIGNS

(Editor's Note: Following is the full text of the report of the Committee of the National Highway Traffic Association on Highway Danger Signs as presented at the 1923 annual meeting of the Association, by Mr. G. C. Dillman, Deputy State Highway Commissioner of Michigan, chairman of the committee.)

It goes without saying that an important function of our national highway system is the erection of and maintenance of adequate danger signs. Each sign should be placed for some specific purpose and the interpretation of any one sign should be the same throughout the country. To accomplish this, danger signs should be standardized in all states. This is a matter largely educational and it will take considerable persuasion on the part of a number of organizations such as the National Highway Traffic Association to convince the many state agencies that they should adopt a system of danger signs that may mean abandonment of the system now in vogue. There has been a general tendency on the part of all states, that have gone into this matter, to create something along lines entirely different than in the neighboring states. Therefore the report of this committee, in view of the many ideas concerning danger signs, will cover certain recommendations that it is believed worthy of consideration by this Association.

Recommended Standard Practice

(1) Danger signs should be uniform in both shape and lettering or convention.

(2) Lettering and convention should be simple so the observer grasps the meaning without undue mental effort.

(3) Color scheme should be limited to black lettering on a white background.

(4) Frequency of display. These signs should be used only where it is very necessary that they be placed as it is believed that too frequent use of them will depreciate their value as a safety measure to the traveling public. Too frequent and unnecessary use of them will discredit the value of such signs.

(5) Location. It is recommended that (a) the erection of the center of the signs be about 4 feet above the center of the road surface; (b) that the sign be located 1 foot outside the outer shoulder line of the road grade; (c) that the sign be located 500 feet back from the source of danger.

(6) Shape of signs. Danger signs be of four different and distinct shapes indicating the degree and nature of danger as follows:

Round indicating R. R. Crossing.
Octagonal, indicating Stop.
Diamond, indicating Slow.
Square, indicating Caution.

(7) Railroad Crossing Sign. The rail-

road grade crossing sign should be circular in shape and 2 ft. in diameter with a cross on it and the letters "R. R" above the horizontal line, one on either side of the vertical bar. (This particular sign has been officially adopted in a number of states.)

(8) Stop Sign. This shall be octagonal in shape, 2 ft. across, with the word "Stop" printed across the face with letters 9 in. high. Such sign should be used where it is dangerous for traffic to advance further without stopping and it is preferable that such sign be displayed in the center of the roadway.

(9) Slow Sign. Signs indicating slow speed shall be made 2 ft. square in size, displayed with its longest dimensions vertical and horizontal, giving it a diamond shaped appearance. This sign might carry such words as "Slow," "Hill," "Curve," "Loose Gravel," "Fresh Tar," "Narrow Road," "Turn," etc. Lettering should be about 9 in. in height diagonally across the face of the sign.

(10) Caution Sign. These signs shall be 2 ft. square so set that the top and bottom of the sign shall be horizontal with the roadway. It may carry such words as "School," "Cross Road," "Side Road," etc.

The Mississippi Valley Association of State Highway Officials, at their last annual meeting at Chicago adopted a committee report embodying the foregoing principles and during the past few months a number of states have adopted a system of highway danger signs in line with these recommendations.

The above recommendations cover only one conventional sign, namely, that for railroad grade crossings. It is suggested that further consideration and discussion be given the matter of convention for signs to mark curves, cross roads, etc.

The subject of automatic and mechanical danger signals and signs may have a proper place in a system of standardized danger signs, but on account of the great variety of these signals some of which are patented and the cost for general use is prohibitive, and the fact that there is a possibility that certain devices will not operate continuously without attention, thus injecting an occasional interval when the traveling public is not adequately protected, such devices have not been considered a part of the recommended standardized system of highway danger signs.

SECONDARY USES OF FIRE HYDRANTS

By John W. Toyne, Engineer, South Bend, Ind.

It was but the outgrowth of the common use, by every one, of the "town pump" that directed the use of its successor, the public fire hydrant, and made it the general temporary water service medium; and it is not surprising that this use of the fire hydrant became universal, especially in municipally owned water utilities.

So universal is this practice that I have failed to find a single municipally owned plant where secondary hydrant service is not rendered, either voluntarily or otherwise, and very few privately owned plants prevent this objectionable practice.

Within the past month, I was in a small city in northern Indiana, and was informed that no service was permitted from the fire hydrants, yet in less than an hour I saw a building contractor, a crew cleaning sewers, a teamster watering his team in a tub, and a tank wagon filling, all using fire hydrants. In two of the cases, Stillson wrenches were being used to operate the hydrants with the usual results, and I noted where a number of other hydrants had experienced the same treatment.

I have talked with a number of city officials relative to this practice and have been surprised at the lack of thought that has been given the two most essential elements entering into the consideration of this abuse of one of the most necessary pieces of fire fighting equipment—cost and reliability.

Thousands of dollars are appropriated for the purpose of fire fighting apparatus—pumpers, hose wagons, deluge sets, aerials, in fact everything that the ingenuity of man can conceive and contrive that will tend to assist the firemen in their work of fighting fire, and surely the administrators of our municipal government would be subject to severe criticism if they failed in their duty in this respect. At the same time, permission will be granted, to almost any one desiring water for almost any purpose, to use a fire hydrant, notwithstanding the fact that the hydrant is not designed as a service connection and that its use as such, not only builds up an exorbitant maintenance cost but reduces the available fire protection.

This latter statement is not merely

assumption based on the law of averages, but is fact, proven by actual conditions that have come under my observation, and no doubt parallel cases have been within the experience of almost every one connected with water utility of fire protection work. I will cite one or two instances—not that they are unique or novel in any way—but because they are pertinent to the subject under discussion. A fire alarm was answered in an addition where the streets were badly cut up through sewer construction. The hydrant that should have been used was tied up with a service line, without even a union and by the time the hose wagon had backed out to another hydrant, the house had burned down. At a hydrant ordinarily used by the street sprinkler for filling purposes, and on which the side cap was usually left open, a handful of small rock was discharged into the fire hose plugging the nozzle and allowing a roof fire, set to wood shingles from an adjacent fire to gain considerable headway before the hydrant could be closed, the nozzle removed and another substituted. Small boys were severely criticized for dropping the rock into the hydrant, but as I see it the criticism was directed to the wrong place entirely.

It would be difficult to estimate the cost in property damage and loss of life that has accrued from this practice and that is continuing as one of our disgraces.

The foregoing discussion is from a paper by Mr. Toyne before the recent annual meeting of the American Water Works Association.

ADDITIONAL SOURCES OF INCOME FOR SMALL WATER PLANTS

By Howard A. Dill, Richmond City Water Works, Richmond, Ind.

Water companies have the advantage over telephone, gas, electric and railway utilities in regard to competition.

For that reason less effort is generally made by water utilities to advertise their product and secure additional consumers, or to increase the consumption of existing consumers. Because water is a necessity and there is no substitute is no reason why water utilities cannot obtain additional revenue by a well planned campaign of advertising and salesmanship. Any superintendent can cite cases of properties which are supplied with well water, instead of by the water mains in front of such properties. Advertising and personal contact would doubtless convince many persons of the desirability of using city water that is protected by laboratory tests, that can be had by opening a faucet, and that is obtained from an unfailing source of supply, all at a cost of a few cents a day. Baths and toilets would be added in many cases if an effort were made by the utility to show customers the convenience and sanitary advantages of such equipment. Sprinkling use could be increased by educating the consumer to the effect of, and enhanced value from a beautifully kept lawn, or a quantity of shrubbery effectively placed about the house.

Water companies could well afford to make a survey to locate properties using well water, and then sell the advantages of city water to the owners of such properties.

Gas and electric companies have demonstrations and exhibitions of their products, and sell equipment using them.

The advisability and desirability of water companies selling material and fixtures at or near cost to customers is a debatable question. There would be objections, of course, on the part of dealers and plumbers, but such a method would undoubtedly encourage the installation of such fixtures. The plumbers, I believe, would be benefited, as the installations would be made by them. In large cities where city water only is used, a possible increase in revenues would be by such methods as indicated.

Softened Water

In smaller cities, however, and perhaps in some cases in larger cities, residences are supplied from cisterns, collecting rain water from the roofs. This requires the additional equipment of a hand pump or of a pressure or gravity tank and an electric motor and pump. By this means softer water is obtained for bath, washstand, kitchen and laundry use. It is from this class that additional revenue can be secured. Cisterns are expensive to construct if of a size adequately to meet the demand. They give trouble from leakage and require frequent cleaning. The electric motor gets out of order and depreciates, and there is also the item of pipe installation.

The Zeolite method of softening water is not new, and is used by laundries, hotels, apartment houses and steam boilers. No additional revenue would be derived from such consumers, as city water would be used by them with or without a softener.

From residents using cistern water, however, there is a decided possibility of increased receipts. A campaign could be made demonstrating the advantages of Zeolite softened water, over cistern water, such as its greater softness, its cleanliness and its reliability of supply.

In the case of new residences, it can be shown that the cost of a Zeolite softener is little, if any, more than the equipment for cistern water. The operating cost of the former is nominal, the salt used costing from $5 to $10 a year. There is no depreciation, the time necessary in operating is very small, and the method is simple. There are several makes of softeners, resulting in closer competition and reduced cost.

A cistern and filter of 80 barrels capacity and electric motor will cost about $250, as compared with the same amount for a softener to supply a family of four with one bath and laundry.

For a family of six, a cistern of 150 barrels, motor, etc., would cost about $350, a softener $335.

For a family of eight or more, two 150 barrel cisterns, motor, etc., would cost about $585, a softener about $500.

Richmond, Indiana, has a population of about 30,000. The water company is a private one, its supply being secured from springs and infiltration galleries, naturally filtered through gravel strata. The hardness of the water is 20 to 22. Most of the residences occupied by the owners have cisterns, the better class of which use electric or water motors to pump the rain water. Electric motors are gradually superseding the water motor, thus reducing the consumption of city water. Within the past two years, probably 20 new houses have installed Zeolite softeners, several of these through the efforts of the water company.

Advertising is being used, and prospective customers shown the comparative advantages and costs of the Zeolite and cistern equipment. The company does not recommend a particular make of softener, but gives the prospect the names of the manufacturers or agents.

The writer installed a softener in December, 1921. The water used the first year for house use and back-washing the softener amounted to 37,500 gals., and the salt used was 600 lbs. If a cistern had been used, the water company would have lost the revenue from the consumption given above.

This is an instance of one possible source of revenue, and one which we believe is capable of development.

The foregoing paper by Mr. Dill was presented at the recent annual meeting of the American Water Works Association.

HIGHWAY TRANSPORT CLEARING HOUSES

By Tom Snyder, Sec. Indiana Transfer and Warehousemen's Association, Indianapolis, Indiana

(Editor's Note: Following is the progress report of the Committee of the National Highway Traffic Association on "Highway Transport Clearing Houses," of which Mr. Snyder is chairman.)

To individualize, standardize, and to stabilize motor transport as a definite force in American industry, requires that motor transport clearing houses be established in all shipping centers, and that the function of these clearing houses be as democratic as the highway itself.

The development of motor transport service is not keeping pace with the demand, nor is the collection of dependable data, covering experience in operating, keeping pace with the growing demand for regulation.

During the past four months twenty-one state legislative bodies considered the question of motor transport regulation, but all of these groups were wholly without such information as would be necessary in forming the first foundation stone for such regulation.

A highway transport house would first centralize the demand and supply for motor transportation, it would be confronted immediately with the problem of freight collection for a certain portion of the demand, and it would be compelled to find the most adequate method of store door, or platform delivery, of commodities transportable.

A clearing house would be required to quote rates for service. These rates would be for store door, platform, or ferry delivery, and in store door delivery would vary with truck load or less than truck load consignments.

To quote constructive rates would require the analysis of cost of operation upon the ton mile basis for various distances, upon various kinds of highways, under conditions peculiar to the season, and with various truck units.

After a very general survey extending from coast to coast, we are thoroughly convinced that the major portion of all motor transport adventures have been

financial failures, due, to a large extent, to the lack of such knowledge as motor transport clearing houses would find it necessary to obtain, as their first function of activity.

Railway terminal congestion and resulting transportation delays have again reached the point of industrial obstruction, and many shippers in every American city are seeking relief in motor transportation. To whom will the shipper appeal for such relief? He may be referred to the Jones Trucking Company, which operates a line to Batesville, also to the Smith Transport Company, which operates irregularly over several other routes, and so on, but he is sure to find a lack of uniformity in methods of operation, in rates, in schedules, and in service responsibility.

The shipper fears to subject his consignees to these questionable conditions, and the benefits of an improved service are lost to all concerned, because the clearing house is not there to connect up supply and demand.

Furniture warehousemen in America are rapidly accepting the theory that a furniture warehouse is the clearing house between homes and that the transportation of household goods either from home to warehouse or from warehouse to home for any reasonable distance is one of the normal functions of the warehouse company.

This accepted point of view is rapidly bringing about a dependable, connected transportation service in moving household goods for constantly increasing distances, and by constantly improving uniform methods providing also for that most important return load.

The commercial warehousemen of America are rapidly recognizing the commercial warehouse as the motor transport clearing house between warehouse supply and the distributor or retailer. These developments of this idea will bring about a great change in the method and cost of distributing society's daily need, and a constantly increasing volume of L. C. L. short haul commodities will move directly from warehouse to the retailer, instead of passing through the shipping department of the jobber or wholesaler.

That class of jobbers and wholesalers whose business consists chiefly of L. C. L. short haul commodities, such as wholesale grocers, druggists, dry goods, hardware, etc., are the greatest sufferers from inadequate transportation facilities. Highway transport operators everywhere are seeking to increase their tonnage demands, but because of the limited resource of the single route operator as compared to the broader and more general need of the shipper, motor transport progress is being greatly retarded.

We believe that all of these scattered forces are now awaiting the centralizing influence of highway transport clearing houses, and recommend that the National Highway Traffic Association begin a campaign of analyzing, through the motor truck manufacturers to their sales departments, to all types of jobbers and wholesalers, through their national and state organizations, to organized traffic clubs through national and state organizations, to individualize commercial warehousemen through their National Association, and to all such organized groups that are now feeling the need of improved transportation resources, the great possibility of such improvement, through the establishment of highway clearing houses.

We recommend that the National Highway Traffic Association confer with the Inter-State Commerce Commission on the early development of inter-state motor transport regulations, especially in the adoption of such regulations as will be applicable in unifying individual state regulations.

We believe that in the enactment of state regulations, especially as to rates, schedules, and fixed routes, great obstructive errors have been and will continue to be made, that the activity of the Inter-State Commerce Commission in seeking applicable inter-state regulations will tend greatly to stabilize state regulations and that the establishment of highway transport clearing houses will develop the information upon which constructive state regulations may be enacted.

Swimming Pool Sanitation: The use of chlorine for swimming pool sanitation is described in technical publication No. 41 recently issued by Wallace & Tiernan Co., Inc., Newark, N. J.

Steel Curb and Gutter Forms: A 4-page pamphlet illustrating the use of steel curb and gutter forms for use on road and street construction projects, was recently issued by The Heltzel Steel Form & Iron Co., Warren, Ohio.

Construction News and Equipment

MECHANICAL DEVICES FOR HIGHWAY TRAFFIC REGULATION

(Editor's Note: Following is the text of the progress report of the Committee of the National Highway Traffic Association on Mechanical Devices for Highway Traffic Regulation as presented at the recent annual meeting of the Association, by Prof. Lewis W. McIntyre of the University of Pittsburgh, chairman of the committee.)

Conclusions

Traffic laws should be enforced on the street by uniformed policemen, but the administration of traffic departments should be in the hands of engineers.

All traffic devices should be designed to have a maximum of visibility.

The color red should not be used for traffic regulation signs, traffic control lights or anything except to indicate danger of the first degree.

There is a definite relationship between the color and the size of a traffic sign in order to secure maximum effectiveness.

Traffic regulation devices must be standardized as rapidly as possible.

Position lights are better than colored lights for traffic control signals.

A joint committee on traffic regulation should be appointed.

Stanchions should not be joined together with chains.

Traffic control devices should be so built as to remain where placed.

Mechanical devices used in traffic regulation must be practically infallible in operation.

One way streets should be indicated by painted arrows.

Wide streets should have separate traffic lanes indicated for fast and slow moving traffic by means of painted lines.

Congestion can be considerably relieved by the correct location of traffic signals with reference to the intersection.

The use of colored lights on semaphores should be abandoned in favor of the position light.

Automatically controlled traffic signals must have a minimum of moving parts and be simple in operation.

Flickering light beacons should only be used to indicate danger of the first degree.

Progressively controlled traffic signals will be more effective in relieving congestion than synchronously controlled signals.

Origin of Traffic Regulation

Traffic regulation originated when policemen were placed on Broadway for the protection of pedestrians from careless truckmen and omnibus drivers. The following quotation from James Blaine Walker's "Fifty Years of Rapid Transit" indicates the situation of that time.

Early New York Traffic Conditions

"According to figures compiled by Sharp in one of his campaigns for a franchise, about 230 omnibuses passed Chamber's street going up Broadway and 240 down each hour. For 13 hours this count, taken in August, 1852, showed that 3,035 omnibuses, and 4,719 other vehicles passed up and 3,162 omnibuses and 4,732 other vehicles passed down Broadway at this point. This meant an omnibus service at 13 seconds headway.

"By the year 1864, conditions had become intolerable. Broadway became unsafe for pedestrians, and we are told that the rivalry between omnibus drivers was so great that they recklessly drove over men, women and children in their haste to beat their nearest competitors to waiting passengers. Reckless driving and crowded omnibuses were not the only grievances. The drivers were accused of swearing at passengers and giving them bad money or tickets in change."

Enforcement of Traffic Laws

With the increase in traffic and the consequent growth of laws and ordinances affecting traffic, more and more policemen were naturally employed in their enforcement. Traffic laws are still and should be enforced upon the streets by uniformed policemen.

Development of Manual Control

It was soon observed that the presence of policemen had an unforseen result. It reduced accidents to vehicles and expedited travel. The control, however, was largely manual. Some of our large cities today use this method exclusively.

(Cincinnati for example) and in most of them it is used to some extent. When the regulation of traffic was first undertaken the efforts of the police were chiefly directed to stopping vehicles, but as they have gradually become more proficient and have acquired a better appreciation of the real purpose of traffic control, their aim has been to keep traffic moving. The raised hand to direct a stop is less frequent, while the arm motion to go ahead is more often seen.

Administration of Traffic Departments

The introduction of the motor vehicle has increased traffic to undreamed of proportions and made other methods of control necessary. The questions of accident prevention and traffic congestion are problems which demand for their solution minds carefully trained in analysis, the engineering type of mind. The administration of traffic departments, involving as it does the study of traffic problems and the making of regulations, should be in the hands of engineers.

Design of Traffic Signals

Few persons realize the importance of the traffic signal in increasing the speed of traffic movement and promoting the maximum volume of vehicle and car movement. However, the problem must be worked out scientifically in order to bring about this maximum movement. The various factors entering are not in any sense vague or indeterminate but must be carefully analyzed for each important intersection.

A Problem of Education

One of the principal problems in traffic regulation is the education of those to be regulated. Effective traffic control is dependent on public understanding and co-operation and if properly conducted it can be made largely automatic.

Mechanical Devices

Mechanical devices for the regulation of traffic must be analyzed from two points of view: safety and the relief of congestion. The following principles should be considered in their design.

Visibility

In detail this means that the upright portions of all stanchions, semaphores, etc., should be painted with alternate bands of black and white from 8 to 12 in. wide. It means that the base of such stanchions should be painted white. It means that the spot on the pavement on which they set should be painted white. It means that spot lights arranged to illuminate the base at night, and in the case of semaphores, the traffic officer is advantageous. It means that unlighted obstructions of every character should be denied a place upon the highway at night, be they stanchions, semaphore or mushroom.

Traffic Signs

Traffic signs should conform to this principle of maximum visibility. They should denote their meaning as far as possible by their shape and color. Probably the best combination consists of vivid yellow letters on a black background. Signs intended for moving vehicles should differ from those intended for stationary vehicles. The latter might have the the colors reversed, i. e., black letters on a yellow background. Signs of a tertiary character such as those for the control of pedestrians, street car stops, etc., might consist of black letters on a white background.

The writer recognizes that yellow does not represent the color of maximum visibility, that red is the most penetrating color. He would not use red on traffic signs, however, for reasons to be explained in the discussion of color.

Color

The use of red as a color for traffic regulation signs, traffic control lights, or for anything except to indicate danger of the first degree is to be depreciated. The promiscuous use of the word "danger" on such signs is also to be frowned upon. Familiarity breeds contempt and the motor vehicle user, having seen the red color used to indicate things which were not particularly dangerous or having seen the word danger quite frequently where caution or warning would have been more appropriate as indicating danger of a secondary or tertiary character, gives much less heed to this color or this word when they do indicate a real danger.

The use of the word danger in connection with advertising should be prohibited. For a driver to read that it is dangerous to go any further without a drink of so and so's coffee makes him much less alert when confronted with a real danger sign. Let us not forget the story of the "wolf."

Relation of Color and Size

The relation between color and size of traffic signs merits serious study. Psychologists tell us that concerning the bill board as used for outdoor advertising, there is a definite relationship between the size of the bulletin and the colors and tints used to secure maximum effect. Halving the size of that bill board will

change the character of the colors and tints which should be used. What is the proper size for various types of traffic regulation signs? The determination should not present insurmountable difficulty.

Uniformity

If we were to collect specimens of traffic control devices from those cities where traffic regulation is active we could fill a museum with signs and signals, no two of which would be alike in color, shape, size or marking. Such a collection would be the best kind of evidence of the need for uniformity. The result of the driver being faced with so many different types of direction is that he disregards all of them to a greater or less degree. In other cities, traffic devices are few and far between.

The citizen of Chicago should be able to obey the traffic rules of San Francisco as indicated by the mechanical devices employed without question. A red light on the traffic tower on Woodward avenue, Detroit, should not indicate stop while the same color indicates go on Fifth avenue, New York, nor a green light indicate go in Detroit while it indicates change in New York.

Standard Traffic Lights

As a suggestion looking toward standardization of traffic lights on towers, the writer would eliminate red for the reasons already named, viz., the reservation of this color for the indication of danger. We might then follow the standard colors in use by our steam and electric railway systems and also as partially adopted by the American Association of State Highway Officials, i. e., yellow, green and white as indicating varying degres of caution and a clear track respectively. Green might indicate stop, yellow change, and white go.

The Position Light

A better arrangement would be the use of position lights instead of colors. The Pennsylvania Railroad, among others, has adopted the position light in place of the old semaphore and colored light.

Such a system consists of a circular disc on which seven lights are placed in such a manner as to give three in a row, either horizontally, vertically or diagonally. Three lamps are lighted simultaneously giving three different possible combinations corresponding to the positions formerly taken by the semaphore arm, i. e., horizontal, verticle or inclined.

Color Blindness

This would eliminate the effect of color blindness in causing misunderstanding of traffic lights of this sort and would be more intelligible even to the total stranger because of its greater simplicity. The effect of color blindness is not such a negligible item as it might at casual glance seem to be. Four per cent of the male population of the United States are color blind to red and green.

As further evidence of this lack of uniformity the writer counted in Pittsburgh four different color combinations on traffic signs in one block, viz., white and black, red and white, blue and white, and yellow and black.

A Joint Committee

This much desired uniformity will not be advanced by having the committees on traffic regulation in various technical societies make individual recommendations with regard to these matters. A joint committee should be appointed with representatives from all organizations interested in the regulation of traffic. The report of such a committee would have much greater weight and be much more likely of universal adoption than the work of a committee from one organization. So numerous and of such infinite variety are the devices for the regulation of traffic rapidly becoming and so confusing is the result, that this subject may soon become the subject of national legislation unless a measure of co-operation is secured between various states and their lesser sub-divisions.

The delegation by many of our cities of the regulation of traffic to aldermen, commissioners and police officers of very limited experience in traffic work has contributed to this confusion. These men, not being content to profit by the experience of others, and frequently without inquiring into this experience, appear to have devoted most of their energies to devising some new form of installation.

American Engineering Standards Committee Report

In this connection the forthcoming report of the American Engineering Standards Committee on Traffic Regulation will undoubtedly be of considerable interest.

Chains

The joining together of stanchions and posts with chain and ropes is dangerous, and can not serve any purpose which the stanchions themselves would not serve. The chains are relatively invisible and are more likely to cause accidents than prevent them. A case in point is some of the safety zones recently adopted

in Detroit consisting of large posts painted white and joined together with chains.

Stability

All devices for the regulation of traffic should be of such construction that they will remain where placed. They should be sufficiently heavy to remain in place during a high wind. Their bases should not be round so as to avoid rolling if knocked over.

Simplicity

Any mechanical device on which the safety of so many people depends must be simple in construction and infallible in operation. Provision must be made for protection against burnt out lights, springs which become misplaced and broken, or any defect in the mechanism that will render the device inoperative. When once installed considerable dependence is placed on such devices and their failure is apt to be much more serious than if they had never been installed.

One Way Traffic

All one way traffic streets should be more plainly indicated than is frequently done at present. Probably the best way of doing this is by means of several large arrows painted on the pavement at each intersection. In lieu of painted lines, white cement blocks have been used in Portland, Ore. They are made of hydraulic cement and celluloid, are hard, tough, and have a glass like finish and are said to be permanent in color.

Traffic Lanes

On wide streets congestion is relieved by painting separate traffic lanes for slow moving and fast moving traffic, the lane for slow moving traffic being nearest the curb. Instead of paint the white blocks described above might be used.

Location

The location of the mechanical devices used merits considerable study. As a typical example it may be said that it is the general custom to place mushrooms and dummy cops in the centers of intersections, all traffic making a left hand turn being required to pass around them. This results in a very small turning radius and a consequently much reduced speed. Should not these markers be placed in the centers of the four property lines and the marker at the center of the intersection be eliminated? This would result in a much larger turning radius and nearly twice the vehicular speed. Neither would it result in vehicles dangerously cutting the corner. What this means in getting more vehicles through an intersection can readily be appreciated when we consider that even if vehicles cross an interesection with undiminished speed, the capacity of the intersection is but 50 per cent of the capacity of either approaching street.

Or where should traffic towers be placed? In the center of the intersection as in Detroit, or behind the property line as on Fifth avenue, New York, and what are the relative advantages of each position? Towers might be placed above the center of an intersection and still not obstruct that intersection by being mounted from a bridge supported on pedestals on the adjacent sidewalk or from adjoining buildings. A clear view of the tower could then be had from both main and cross streets.

Classification

Mechanical devices for the control of traffic can be further classified according to their method control under four general headings: Manually controlled devices, automatically controlled devices, semi-automatically controlled devices, and synchronously controlled devices.

Manually Controlled Devices

Under the first heading, that of manually controlled devices, we can place all standards, dummy cops, semaphores and certain types of mushrooms, standards and dummy cops.

An application of the principles above set forth of visibility, color, uniformity, simplicity, use of chains and stability should make the satisfactory design of such devices a simple matter. Yet how often are these principles violated. The writer recalls a recent experience related by a friend in his home city. While driving into the entrance to one of the parks at dusk, he observed a machine going in the opposite direction, making a terrific racket, and dragging what appeared to be its whole rear end on the road. On going a little farther the trouble was easily diagnosed. A few days before the police had placed down the center of the roadway a series of standards bearing signs "Keep to the Right.' The bases of the standards were round and black in color. The upright portion was also painted black, the signs had white letters on a red background, they were connected with chains and were unlighted. When my friend saw them they were also scattered all over the road.

Semaphores

The number of existing types is legion. The simplest type may be said to be the beach umbrella with the words stop and go painted on the sides and con-

trolled by the traffic officer underneath, who is usually in as much doubt regarding the reading of his signs as the vehicle driver is concerning whether to stop or proceed. The correctly designed semaphore has been partially described in discussing the principle of visibility. In addition it should have lights mounted on the ends of the semaphore arms indicating their position at night. The writer would not see a light on top of the semaphore standard.

The semaphore arms themselves should conform in color to the principles already indicated and should be constructed so that they can be placed in a neutral position when no traffic officer is on duty. If in addition the traffic officer is provided with a small light on his chest, we have the maximum in visibility, clearness and stability.

Mushrooms

Mushrooms or buttons serve a useful purpose in outlining safety zones and traffic paths. They should be very strongly constructed because they are occasionally run over by very heavy vehicles. They should never be placed upon the highway unless capable of being lighted at night. Their visibility should also be increased by the frequent use of white traffic paint. The type which disappears when struck by a vehicle would seem to be advantageous provided that under service they prove to be mechanically stable.

Automatically and Semi-Automatically Operated Devices

The automatic and semi-automatically controlled devices differ only in that the latter is capable of being operated manually or automatically at will. Under this heading we can place lighthouses, certain types of mushrooms, traffic lanterns, and traffic vanes. One of the principles involved is that every so often the signals change, thus allowing traffic to pass first in one direction, then in the other, the period of change being entirely controlled by the mechanism. The usual signalling is done by means of lights of various colors, either placed in mushrooms situated variously about the intersection, in traffic lanterns suspended over the intersection or attached to poles at the curb line or by a combination of the two. One device, however, consists of an arrow with the word stop on both sides. It is suspended in the center of the crossing by overhead wires and rotated by a motor directly above it. A whistle blows while the arrow is moving. It is illuminated at night and can be operated either from a box at the curb line or from fire headquarters. By such central control a complete route can be cleared in case of necessity.

Lighthouses

The other principle involved is that of the flickering light. The actual device varies, some being lights placed in mushrooms, some on standards, some electrically lighted and operated, and some lighted and operated by gas. Advocates of the use of these devices claim that the intermittent flashing light stands out sharply and distinctly from all other lights and commands attention. This is undoubtedly true. Opponents, however, claim that it distracts the attention of the driver and produces fatigue particularily at a time when he should concentrate on possible danger. The writer heard one highway commissioner state that he would give every lighthouse in his state to anyone who would pay the freight on them, and another commissioner from a different state as quickly replied that he would pay the freight.

A combination of the lighthouse and illuminated mushroom or button is used in central islands in large intersections when rotary traffic is instituted.

Flickering Light a Good Danger Signal

The writer believes that the use of such beacons should be confined to danger signals, indicating danger of the first degree and installation be permitted only under the strict supervision of the highway authorities. He also depreciates their installation as advertising mediums. As marine signals they have undoubtedly proven desirable and dependable. The highway signal is capable of somewhat further development.

In all such devices as have been mentioned, emphasis must be placed on simplicity. The device with a large number of moving parts and doing a number of different things should be scrutinized very carefully.

Synchronously Controlled Devices

The increasing congestion in our larger cities and the nearness with which our streets are reaching their capacity has made it desirable to control traffic in larger units than the single block. This has caused the development of the various synchronously controlled devices, practically any of the devices using lights being capable of this method of control.

The Traffic Tower

The foremost example of this type of device is the traffic tower or crow's nest used either by itself or in combination with traffic lanterns and mushrooms. This is the most difficult type of traffic regulation.

As usually practiced this type of control has simply minimized the delays in starting and stopping at cross streets, through the visibility of the signal over greater distances and through the movement of a somewhat larger unit than the single block. It has by no means reached the limit of its possibilities. It should be possible through accurate counting and charting of the traffic at each intersection to determine the exact length of time required for the traffic to pass through that intersection, every way, at every time of day.

Platoon Control

By a carefully worked out scheme of progressively changing the traffic lights along the main thoroughfare, instead of synchronously changing them, traffic might move in platoons, so that a vehicle once having joined a platoon would remain in that platoon throughout the length of its journey. This platoon having once started would not stop until it had traversed the complete length of the main thoroughfare, except in case of emergency. Depending upon the speed this platoon was permitted to have, either the maximum capacity of the thoroughfare could be obtained, or the minimum length of time taken to traverse the length of the thoroughfare. This itself could be varied depending on the time of day.

Master Streets

In most cases it will be found that a large degree of control will be exercised on traffic on the main thoroughfares by certain master cross-streets such as 42nd Street, New York. By the progressive change of the traffic signal, however, the influence of this master street would be minimized and traffic having passed it would no longer be under its influence.

Cumulative Effect of Traffic Delay

The write desires to call special attention to the cumulative effect of a traffic delay. This is illustrated by a recent investigation on the Interborough subway. It was found that the delay of one train two minutes resulted within one-half hour of every train on the system being ten minutes late.

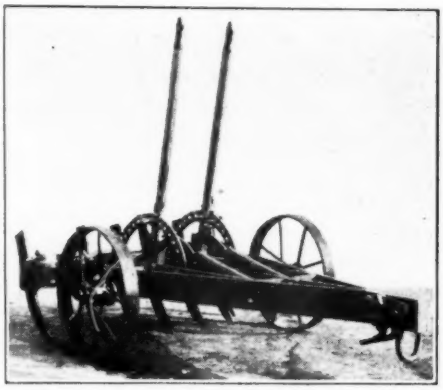
Painted Lines

One feature of the painted line in assisting traffic which the writer has never heard mentioned is its value in helping overcome the effect of glaring headlights. The reason why the bright head light is so serious is that the driver coming from the opposite direction looks directly at it. I have found that it take a conscious effort to look away. In cities the situation is further complicated by the many other distracting lights.

The painted center line supplies something for the driver to focus his attention upon with the assurance that as long as he remains on his side of the line he will pass the cars coming from the opposite direction in safety.

THE LAKEWOOD GRADEROOTER

The Graderooter is a new piece of paving equipment brought out this season by the Lakewood Engineering Co., of Cleveland. This machine, here illustrated, has been found particularly useful in scarifying the subgrade preliminary to mechanical subgrading. It is used also for practically all of the scarifying work



THE LAKEWOOD GRADEROOTER

found on the average road job and is built very heavy to stand up under severe service. Some contractors are using it in place of a rooter plow. It is also being used for maintenance work by state as well as county highway departments.

The graderooter is furnished with two sets of five teeth each, and one special manganese tooth alone for particularly heavy work. The machine weighs about 1,300 lbs. and can be furnished for tractor or team hitch.

NEW SIZE P. & H. GASOLINE SHOVEL

A 1 yd. capacity shovel, operated either by gas or electricity, has been brought out by the Pawling & Harnischfeger Company, of Milwaukee, Wis. The new machine is very similar in design to the P. & H. ½ and ¼ yd. machines, which are being so widely used in all parts of the United States and even in India and Japan.

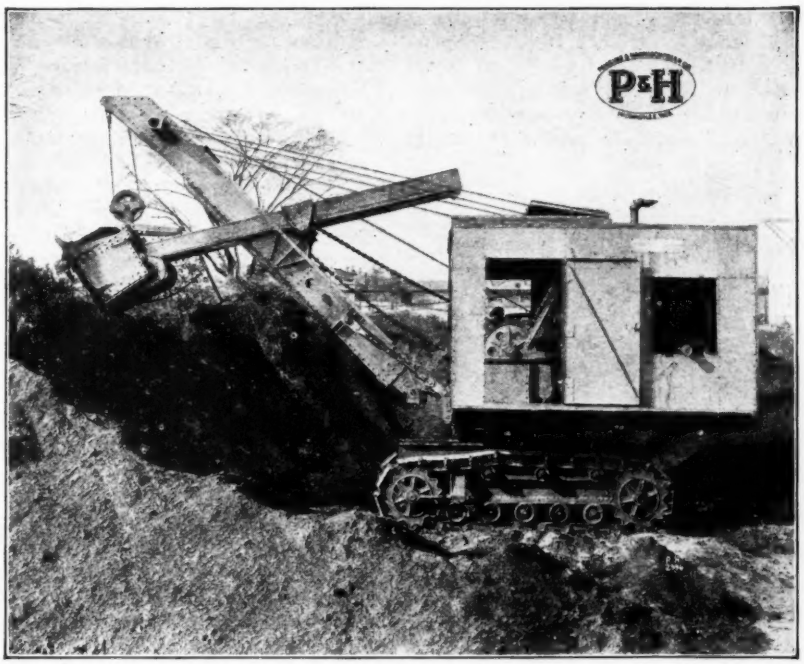
Being driven by gasoline or electric motor the machine is operated by one man, no fireman being required. The saving in this one man's wages alone is considerable.

tor to bite into the heaviest digging.

The machine is designed to come within standard railway clearances with only a minimum amount of dismantling. This is a very important feature for machines that have much moving to do.

The shovel is mounted on P. & H. corduroy traction, so called because it really lays its own corduroy road. The traction is very rugged being built entirely of steel and is non-cloggable even in the heaviest going.

A large southwestern railway system is using two of these machines with gasoline motors on new right of way construction; a large stone quarry has purchased one with electric motor; and irri-



THE NEW SIZE P. & H. GASOLINE SHOVEL.

Another excellent feature of the gasoline or electric drive is the practical elimination of fuel and water hauling expense. Another advantage is the ease of operation in inaccessible places.

The crowding motion of the 1 yd. shovel is of the standard P. & H. design. A manganese rack on the dipper stick is driven by a heavy thimble roller chain from a set of planetary gears. These gears are mounted on the forward drum of the machine. This gives a positive crowding motion regardless of the position of the dipper and enables the operagation district in the Southwest has also purchased one.

In addition to being used for a shovel, by a simple change of booms, this machine is used with drag-line, clam-shell, pile-driver, crane hook, etc.

GRAVEL HEATER AND DRYER

The Littleford Gravel Heater and Dryer No. 74 is manufactured under the C. A. Mullen patent, and makes use of a very simple principle, whereby the combined power and heat and ventilation make dry-

ing and heating very rapid and thorough. It will heat all kinds of crushed stone and gravel, but because of its construction, can not be used for sand. It is adaptable for use by paving and building contractors, roofers, street railways, maintenance departments, etc. It is indispensible for winter concreting when large quantities of hot materials are needed.

The heater and dryer is made entirely of plate steel and consists of a large fire chamber with sloping walls of perforated steel extending upward to a point at the base of the charging hopper. At different levels but uniformly spaced from these walls are additional perforated walls or flights.

In operation, the material to be dried is loaded into the hopper at the top from which it feeds by gravity into the open flights on both sides of heater . As it is suspended, in a thin layer, against the perforated sides of the fire chamber, the heat passes directly to and through it

THE LITTLEFORD GRAVEL HEATER AND DRYER NO. 74.

carrying away every particle of moisture. Hot dry material continually feeds to the base where it can easily be removed.

This equipment is mounted on heavy steel wheels and axles which are machine turned and fitted with standard axle nuts. A suitable handle is provided for drawing it about. It is made in two sizes which have heating capacities of two and four tons per hour. It is manufactured and sold by Littleford Bros., 460 E. Pearl St., Cincinnati, Ohio.

TRADE NOTES

The American Gas Accumulator Company, of Elizabeth N. J., who make traffic beacons and highway lighthouses, have opened a New York office at 100 East 42nd Street, in the new Pershing Square Building opposite the Grand Central Station. In an effort to solve the traffic problem and reduce the number of automobile accidents, this company has developed a traffic engineering department which makes a survey of municipal traffic conditions, bringing to bear known engineering principles in other fields. It is an interesting point to know that these flashing traffic beacons and highway lighthouses operate in the same manner as the government buoys and lighthouses in the harbors of the United States, and other parts of the world. They are sister lights to the recently installed aviation routing beacons of the U. S. air mail service, located every three miles from Chicago to Cheyenne to guide the transcontinental night flyers.

A gasoline impact drill of the air hammer type is now manufactured by the Pennsylvania Gasoline Drill Co., Land Title Bldg., Philadelphia, Pa. The drilling unit is a self-contained, portable, gasoline hammer, so powerful and compact that one man operates and transports it from place to place. Like the self-contained gasoline engine, this gasoline hammer makes its own power, therefore no other power equipment has to be transported with it. When first seen in operation, the lack of connection to other agency of power causes wonder and forcefully brings a realization of the terrific power of gasoline when applied directly to the hammer piston of this drill. The drill is a demonstrated success and is so regarded by large users of drilling equipment.

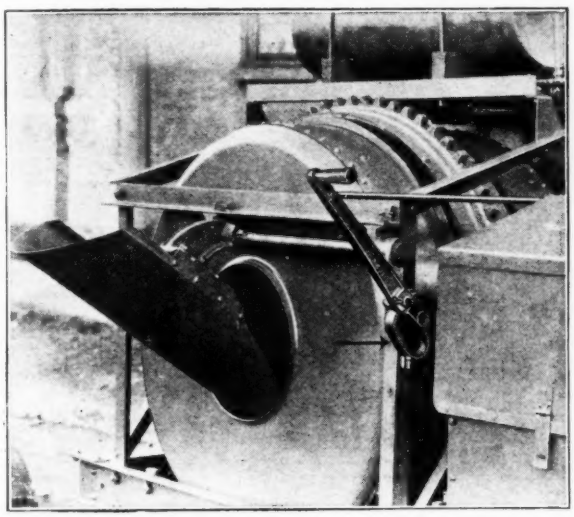
A new type of deep well pump has recently been perfected by the Worthington Pump & Machinery Corp., 115 Broadway, New York, operating on a principle heretofore not used in pumps of this kind. Although the pump is of the rotary class the water is not elevated by means of a conventional type of impeller but a form of propeller is used very similar to that employed for propelling ships.

The Chausse Oil Burner Company has been incorporated to manufacture oil burning apparatus for asphalt street repairing, for installation in electric railway cars, for production of house furnace burners and the manufacture of oil burning hand torches. The Company is incorporated for $100,000 and its officers are: W. McK. White, president; W. G. Chausse, vice-president; Wray P. White, secretary. Offices have been opened at 206 Lincoln Building, Detroit, Mich., and plans are being made for the location of

a factory either in Detroit or in a nearby city. The apparatus which the Chausse Company will make has been produced in a small way for several years for use by steam and electric railways, street paving contractors and municipal boards of work. The 3 gal. Chausse torch has been a standard in steam railway signal departments for several years in use for thawing switches and signal mechanism.

IMPROVEMENT IN MIXER CONSTRUCTION

One of the interesting improvements noticed in the construction of concrete mixers this year is the new device used on the 7-S mixer made by the T. L. Smith Co. of Milwaukee, for operating the discharge chute. The simplicity of this mechanism is shown in the accompanying illustration.



NEW DEVICE FOR OPERATING DICHARGE CHUTE OF SMITH MIXER.

The operating lever is pivoted to a short arm that is keyed to the shaft to which the chute is attached. When the operating lever is moved, a small roller, attached to the end of the lever, follows the outline of a cam that is bolted to the mixer frame. Except for the rod which extends across the mixer to enable the chute to be operated from the other side, these few simple parts constitute the complete discharge operating mechanism.

In the illustration the lever is shown in its extreme forward position. The chute is locked securely in the position for mixing and where it in no way interferes with the mixing action. Pushing the lever back moves the chute into the discharging position. In the full discharge position the chute is locked and does not have to be held. The peculiar shape of the cam provides the locking feature in each position, no other arrangement being necessary. Releasing the chute from either position is merely a part of the operation of moving the chute from one position to the other. The operator simply takes hold of the handle and moves it forward or backward, according to the position of the chute. By this new method the chute operates easily and quickly.

THE LITTLEFORD TRAIL-O-HEATER

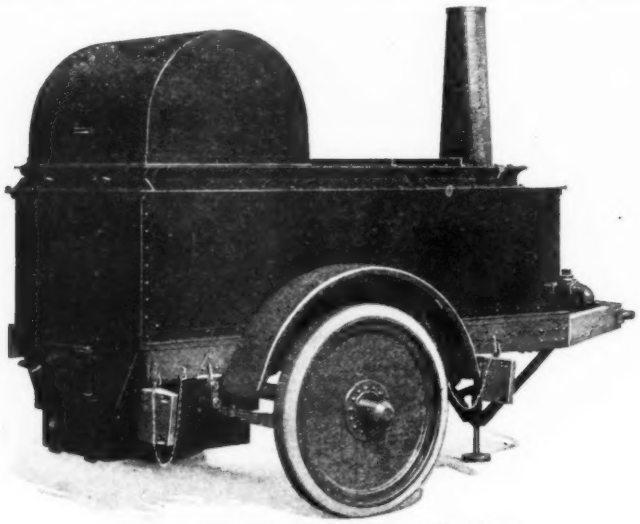
The problem of what to do with the many army trailers now lying unused in the storage yards of the state and county departments and cities has been solved by Littleford Bros., 460 E. Pearl St., Cincinnati, O., who have designed a tar and asphalt heater which is expressly made for mounting on the army trailer chassis.

The placing of a tar and asphalt heater on a spring suspended chassis with rubber tires and roller bearing wheels has solved transportation problems which in the past had limited the use of this kind of equipment. With this superior running gear, a tar and asphalt heater can be trailed behind rapidly moving vehicles

in safety, which enables the highway department to cover more mileage and do better work.

With this equipment, where the "patrol system" of maintenance has been inaugurated, the repair gangs will cover their districts more frequently and with greater efficiency and economy, and when not used in this capacity it is large enough to be used at the central mixing plant.

The kettle of this heater has a capacity of 300 gals. All seams are electric welded. A 2 in. draw-off valve is provided on each side. The cover is arranged with a warming hood under which a barrel of tar or asphalt may be placed for draining. The furnace shell completely surrounds the kettle. It is supported on each side and bolts securely to the chassis frame. It has a large fire box with an improved type fire door and renewable grate bars conveniently located at the rear. It is provided with a large ash pit and draft control door.



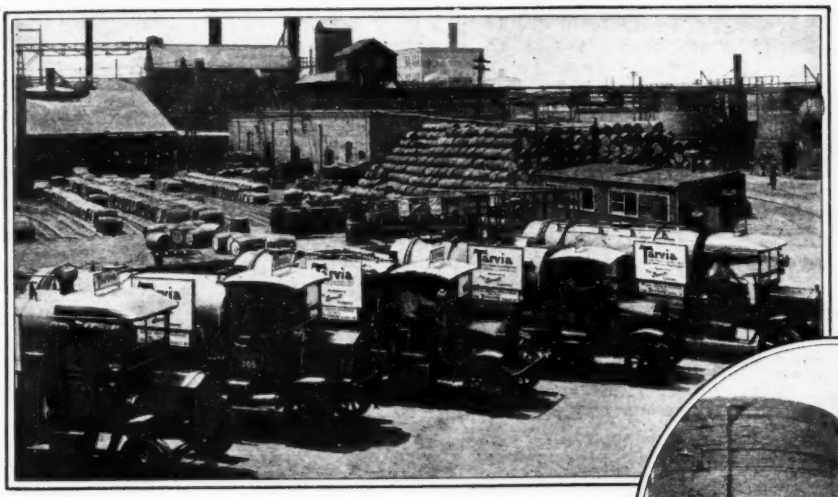
THE LITTLEFORD TRAIL-O-HEATER.

TRADE LITERATURE

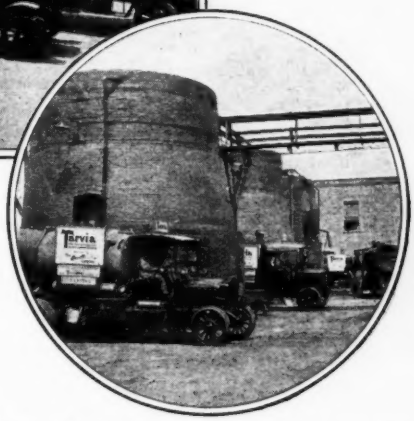
Road Machinery—Improved road making, maintenance and earth handling machinery is illustrated and described in a 32-page, 6x9 in. catalog, entitled: "Signs of Better Roads," recently issued by the Austin-Western Road Machinery Co., Wrigley Bldg., Chicago. The following equipment is covered: road graders, back slopers, grader-scarifiers, double-ender, elevating graders, road oilers, culverts, the "pup" roller, maintenance machinery, road drags, wheeled scrapers, drag scrapers, fresno and tongue scrapers, plows and ditchers.

Austin Double-Ender—The Austin double-ender, characterized as the most useful road grader improvement of recent years, is illustrated and described in an 8-page, 6x9 in. pamphlet, issued by the Austin-Western Road Machinery Co., Wrigley Bldg., Chicago. This is a simple but powerful attachment permanently connected at both ends of the grader blade. Its use increases the amount of work the grader can do and the number of functions the grader can perform. It is made for every size Austin grader. When not in use the attachment is tucked back of the blade and is not in the way. When wanted the extensions are swung forward and a bolt dropped in the quadrant hinge holds them out. This increases the length of the 12 ft. blade to 18 ft.

Irrigation Pumping—The pumping and water distributing system of the Lindsay-Strathmore irrigation project in Tulare County, California, is described in a well illustrated leaflet issued by the De Laval Steam Turbine Co., of Trenton, N. J. This district is an irregular tract on the foot-hills of the San Joaquin Valley, 62 miles south of Fresno, and contains 15,500 acres, of which 8,000 are planted with oranges and lemons. The water supply is obtained by pumping from wells in the delta of the Kaweah River, and is lifted to the high level flumes and pipe lines by large centrifugal pumps driven



A fleet af Tarvia Motor Trucks at the Chicago Plant



"What Do You Mean by Tarvia Service?"

HUNDREDS of men interested in the building and maintenance of good roads have asked us this question. Here is the answer:

First of all, Tarvia Service means that we put at your disposal the skill of highly trained road engineers—men with years of experience in all types of road construction. Without obligation, these men will assist you in solving your road problems — construction, maintenance or repair.

The next phase of Tarvia Service—and a most important one—is the prompt dependable delivery which the strategic location of our branches assures. Moreover Tarvia is shipped in the form most practical to your requirements—by our own fleet of tank cars, in barrels or by motor trucks.

Where it is delivered by motor trucks, we follow a truck-dispatching schedule as punctual and dependable as that of the great trans-continental trains. These trucks are manned by trained experienced crews who lend their skilled co-operation in the application of the Tarvia.

In brief, Tarvia Service is a real aid to the road officials of any state, city, town or community where prompt, efficient road construction is the need. A line to our nearest branch office will start the wheels moving.

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St. Louis	Cleveland	Cincinnati	Pittsburgh
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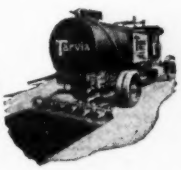
Youngstown	Milwaukee	Toledo	Columbus
Baltimore	Syracuse	New Orleans	Rochester



THE BARRETT COMPANY, Limited
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by electric motors receiving power from a long-distanced transmission line. It is well brought out that by good engineering and the use of modern, large and highly efficient pumps, irrigation can be introduced in extensive tracts that were formerly either too distant from or too high above the water supply to make their development profitable.

Road Oilers, Sweepers and Sprinklers—The Austin line of road oilers, sweepers and sprinklers is adequately presented in Catalog H, issued by the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago. This is a handsome catalog of 40, 9x12 in. pages. It illustrates road oilers, heater attachment, oiler units, trailer units, street sprinklers, sprinkler units, street sweepers, sprinkler-sweepers, brooms, motor sweepers and other Austin machinery. The catalog gives much valuable information on road oiling, street sweeping and sprinkling, etc.

Segment Sewer Blocks—Official Test Data on Laclede-Christy Segment Sewer Blocks are presented in a bulletin issued by the Laclede-Christy Clay Products Co., St. Louis, Mo. The results of tests made by Prof. J. L. Van Ornum, of Washington University, St. Louis, are given in detail.

Water Softening Equipment—Graver Zeolite Water Softening Equipment is described in Bulletin No. 509 issued by the Graver Corp., East Chicago, Ind.

Portable Electric Tools and Shop Equipment—The Black & Decker line of portable electric tools and shop equipment is presented in Catalog No. 5 issued by the Black & Decker Mfg. Co., Towson Heights, Baltimore, Md. The line includes: electric grinders, valve grinders, screw drivers, electric bench and pedestal grinders and electric air compressors. The catalog contains 32, 8½x11 in. pages, and is attractively printed.

Trailers—The use of trailers for reducing hauling costs in modern freight transportation is illustrated and described in a catalog issued by the Detroit Trailer Co., 954 E. Milwaukee Ave., Detroit, Mich. Trailers are shown for the hauling of milk, lumber, coal and merchandise. This company also builds a passenger bus trailer which will carry 80 people safely at a speed of 18 miles per hour, it is claimed.

Excavating Equipment—The Pawling & Harnischfeger Company, Milwaukee, Wis., Manufacturers of Cranes and Excavators, have recently issued new bulletins featuring P. & H. Excavating Equipment. Their 58-X Bulletin features the clamshell, dragline, orange peel, backfiller, crane hook, electro magnet and pile driving rig, with which the P. & H. Excavators may be equipped. The 16-X Bulletin features P. & H. Trenching Machinery. Their Testimonial Bulletin is made up of a series of letters written by a few of the many users of P. & H. Machinery.

Excavator and Loader: "Smith Excavator and Loader" is the title of an attractive, 20-page, two-color catalog just issued by The T. L. Smith Company of Milwaukee. In addition to the usual description, illustrations, and specifications of the excavator and loader, there are several pages devoted to the five uses for which the machine is designed, namely, (1) Basements and general excavating and loading; (2) Bank excavating and loading of gravel, sand, etc.; (3) Stock pile loading of gravel, sand, coal, etc.; (4) Stripping of sand, gravel, clay and rock; (5) Grading of alleys, streets and general work. The new catalog also contains facsimiles of seven letters from contractors who own and operate Smith Excavators and Loaders, together with numerous illustrations of these machines on typical jobs.

Truscon—I Construction: A recent important advance in construction methods for large buildings is the Truscon—I Construction described in literature issued by the Truscon Steel Co., Detroit, Mich. Combining the essential advantages of both reinforced concrete and structural steel, this type of construction has been successfully used in large buildings in all parts of the country. It retains the economy of steel inherent to reinforced concrete but eliminates the expense and inconvenience of form work. It has the self-sustaining qualities of structural steel but eliminates its excessive steel tonnage. Although publicity has not heretofore been given to this type of construction it is now definitely established as shown by the fact that millions of square feet of it are in successful use. The pamphlet "Truscon—I Construction Illustrated" shows the character of the work and quotes some of the endorsements it has received. Many authoritative tests have been made on this construction and some of the facts and figures derived from these tests are summarized in a book issued by the Truscon Steel Co., entitled "Load Tests." Generally this construction has the approval of the building departments of principal cities.

Contracts Awarded

ROADS AND STREETS

Ala., Montgomery—Nixon & Phillips, Lineville, Ala., awarded contract by State Hwy. Dept., to build 2 rd. projects as follows: Henry Co., 11.799 mi. sand and clay rd. from Abbeville no. to County line, at $68,652; Barbour Co. 13.537 mi. sand and clay rd. from so. west cor. of Co. thru Clio, to pt. 5 miles no. east of Clio toward Clayton, at $67,383.

Ala., Montgomery—State Hwy. Dept. let contracts for grading and gravel surfacing 25 miles road from Opp to Florala, Covington Co., to Stanley & Singer, Lafayette, at $244,291; 10 miles bet. Evergreen and Bellville. Conecuh Co. to Keenan & Kyser.

Ark., Little Rock—Oliver Constr. Co., Little Rock, awarded contract to grade and gravel surf. 14 miles Perryville rd. bet. Forest Park and Prothro's Camp ground, at $154,600.

Cal., Calipatria—G. W. Cushing, Richmond, Cal., (also 1501 Brook Ave., San Diego) awarded contract by City Trustees, for paving Main St. and Holabird Ave., at abt. $80,902.

Cal., Long Beach—Two Miracle Concrete Corp., Great Falls, Mont. (temp. address, Alexandria Hotel, Long Beach) awarded contract at approx. $486,000 for improving streets and constructing storm and san. sewers in Dist. 4, or the Belmont Shore Dist., involving 870,746.91 sq. ft. 5-in. concrete paving including grading at 27c ft.; 33,610.19 ft. curb at 70c ft.; 168,573 sq. ft. walk at 21c ft. Contr. also includes storm drain requiring 10,923 ft. reinf. conc. pipe 6-in. to 42-in. diam.; san. sewer requiring 54,326 ft. cem. pipe from 8-14 in. diam., 1,377 ft. 12-in. cast iron pipe, 202 manholes, 4 flush tanks, 71 lampholes and 78 catch basins also sewage pumping plant with pneumatic ejectors costing $22,400.

Cal., Los Angeles—Geo. H. Oswald, 366 E. 58th St. awarded contract for impvt. of Diaz Ave.—Rita St. to Ventura Blvd.—at $45.111, involving grading at $6,500 (lump sum,; 194,772 sq. fe. Topeka paving at 19.4c ft.; 290 sq. ft. grading and oiling at 9c ft.; storm drain complete, $800. H. H. Peterson, Loma Portal, awarded contr. by Co. Supvrs., for impvt. of Ocean Ave. bet. east City limits of Long Beach east to Avenue 19 at $60,700.

Cal., Santa Ana—Steele Finley, Santa Ana, awarded contract by Co. Supvrs., for road constr. in Rd Imp. Dist. No. 20, La Habra, at $199,640.

Ct., Hartford—E. Balf & Co., State St. awarded contract for paving 6,100 ft. Park St., 3-in. asph. on 6-in. base. Engr.'s est. $156,000; 2613 ft. Broad and Webster Sts., 40 ft. and 30 ft. respect., 3-in. asph. on macadam. Est. $42,000; 3,285 ft. Wash., and Ann Sts., 41 ft. and 10 ft. respect., 3 in. asph. on 6-in. conc. Est. $65,000; patching 10,000 sq. yds. Est. $26,000.

Conn., Manchester—E. Balf, 26 State St. Hartford, awarded contract for paving 4,000 ft. Main St., 80 ft. 3-in. asph. on 6-in. concrete, at $92,000.

Fla., Lake City—C. F. Lytle, Jacksonville, Fla., awarded contract to hard surface with concrete 2 sects. of road No. 2, so. of Lake City, Columbia Co., Proj. Nos. 27-A and B, at $493,926.

Fla., Miami—T. B. McGahey Co. awarded contract at $300,000 for $158,268 sq. yds. bitum. pavement, penetration; J. F. Morgan & Co., at $300,000 for 75,887 sq. yds. sheet asph. paving. Both contractors located in Miami.

Fla., Miami—Bunnell & Call, awarded contract to lay 75,498 sq. yds. concrete sidewalks, at $150,000.

Fla., Tallahassee—Barber-Fortin Co., Gainesville, awarded contracts for constr. of broken stone base course on 5 mil. rd. bet. Sharpes and Titusville, Brevard Co., 5 miles road betw. Bonaventure and Eau Gallie, Brevard Co. and 14.4 miles bet. Bunnell and Volusia County line, Flagler Co., at $89,326, $87,930 and $186,900, respectively.

Ga., Atlanta—State Hwy. Comn., let contracts for 6 road projs. as follows: Polk Co. 5.03 mi. chert rd. to R. L. Killian Co., at $104,525; White Co. 9.996 mi. top-soil rd. to Nichols Constr. Co. at $86,862; Bibb & Wayne Cos., 7.1 miles sand clay rd., also 11 creo. timber brdgs., and 100 ft. steel span brdgs. to Dales & Co., at $57,739; Lumpkin Co., 3.32 mi. top soil rd. to T. P. Wright, Atlanta, at $28,153; 1.64 mi. in Echols and 4.01 miles in Lowndes Cos., to Bryson Livestock Co., Jacksonville, Fla.

Ind., Indianapolis—McCoun Constr. Co., Noblesville, awarded contr. by Marion County Commrs., for constr. of 5-mile conc. pavement on Michigan Rd. northwest of Indianapolis, at $196,643. Contract calls for use of Indiana stone.

Ia., Manning—J. S. McLaughlin & Sons, Mankato, Minn., awarded contract for paving, curbing and guttering here, at $155,480.

Ky., Whitesburg—Commofori Constr. Co. Whitesburg, awarded contr. for constructing 8 miles highway from Whitesburg to Harlan, Letcher Co., at $112,000.

Ky., Frankfort—State Hwy. Comn., let contracts to grade, construct draining. structs., etc. on 8 roads as follows: Morgan Co., 15.925 mi. W. Liberty-Frenchburg Rd., to Ellis & Smeathers, Owensboro, Ky., at $198,125 for rein. conc. pipe; Kenton Co., 10.282 mi. Covington-Falmouth rd. to Herman Hughes Constr. Co., Cincinnati, O., at $344,550 for rein. conc. surf., with conc. pipe. Central City-Calhoun Rd., from end of State Proj. 10 to McLean Co. line, Muhlenberg Co., 4.37 miles Central City-Calhoun Rd.—end of St. Proj. 10 to McLean Co. line to J. C. Ellis, Owensboro, at $21,803 for impvts. with rein. conc. pipe; Henry Co., 3.917 mi. New Castle-Shelbyville Rd.—New Castle to Eminence—to Berman Adams, Winchester, Ky., at $37,273; waterbound macad. with local stone. Webster Co., 3.879 mi. Dixon-Henderson Rd.,—Henderson Co. line to end of FAP 34, to W. C. Carter, Clay, Ky., at $21,029; rein. conc. pipe; Webster Co., 4.915 miles Dixon-Madisonville Rd. from Hopkins Co. line to end of FAP 34 from J. C. Ellis at $31,136 for rein. conc pipe; Harlan Co. 5.905 mi. Harlan-Pineville rd.—Wallins to Bell County line, from Eastern Constr. Co., Harlan, Ky., at $77,797, for rein. conc. pipe.

Ky., Frankfort—R. B. Tyler & Co., Louisville, awarded contracts to improve 2 roads as follows: Hardin Co., 6 miles, Western Dixie Hwy.—Red Mill to Hart Co. line, waterbound macadam surf. at $42,179; 9 miles watebound macad. surf. on Western Dixie Hwy.—so. corp. limits of Elizabethtown to 9 mi. so. and nr. Red Mills, at $65,154.

La., Alexander—A. E. Perry, Colfax, La. awarded contract to pave 5th St.—Scott to St. Ann Sts.; pave, lay walks and curbs and construct storm sewer on 7th St. from Monroe to Casson, at $150,399.

La., Colfax—A. E. Perry, Colfax, awarded contract for paving 5th St.—Scott to St. Ann Sts.—vertical fibre brk. on conc.; also storm sewer in 7th St. at $150,400.

Md., Baltimore—P. Flannigan & Son, Harford Rd. & Balt. & Ohio R. R., awarded contract for 21,010 sq. yds. Contr. 234NA. asph., at $91,136.

Mass., Boston—L. Carchia, West Roxbury, (Boston, P. O.) awarded contract for bitum. macadam paving 3.75 miles rd. 18-20 ft. in Burlington bet. Woburn and Billerica, at $131,919.

Mich., Grosse Pointe—(Detroit P. O.)—G. R. Cooke, 1260 Penobscot Bldg. Detroit, awarded contract for grading and paving 18,350 sq. yds. Neff Rd., sheet asph. on 6-in. conc. with conc. curb, at $100,000.

Mich., Holland—Richard Overweg, City Clerk, let contract to H. J. Glovver & Son, Muskegon, Mich., for 75,000 sq. yds. asph. pavement, at $202,708.

Mo., Jefferson City—Following contracts let by State Hwy. Dept.; to grade, construct drainage structs., etc.: Callaway Co., 2 sections to Tim Ryan & Sons, Missouri Valley, Ia.; 5 miles from Fulton to Jeff. City, St. Proj., Route 15, Sec. 48, at $22,571 and 3.655 mi. from Fulton to Jefferson, St. Proj., Route 15, Sec. 49 at $13,363; Clay Co., 3.171 mi. conc., from N. Kans. City to Excelsior Springs, St. Proj. Route 10, Sec. 1, to Highway Constr. Co., Webb City, Mo. at $97,196; Stoddard Co., 2.898 mi. conc. from Fisk to Porter. St. Proj., Route 16, Sec. 83, to Service Construction Co., Poplar Bluff, Mo., at $104,738.

Mont., Great Falls—Fitzgerald & Staunton, Great Falls, awarded contr. for 11 miles gravel surface bet. Cascade and Ulm, at $80,366.

Neb., Beatrice—Abel Constr. Co., 318 Terminal Bldg., Lincoln, awarded contract for asph. concrete paving at $80,000.

Nev., Carson City—Dodge Bros. & Dudley Contg. Co., Fallon, Nev., awarded contract for constr. of Sec. F. Rte. 6, state hwy. in Clark Co. bet. Crystal and west slope of Mormon Mesa, 20.72 miles at $185,181.

N. J., Morristown—C. H. Winans Co. 205 Broad St. Elizabeth, awarded contract by Morris Co. for paving 2½ miles Valley Rd. amesite on conc., at $118,773.

N. Y., Oneonta—W. P. McDonald Constr. Co. 17 W. 42nd St. N. Y. City, awarded contract for curbing, guttering, asph. conc. and rein. conc. pavements, etc., at $204,337.

N. Y., Troy—Fitzgerald Bros. Constr. Co., Inc., Proctor Bldg., awarded contract for repairing asph. pavements at $3.10 per c. y., and $13 per ton for binder, total $25,000; conc. paving 2nd Ave. to Belmar Contg. Co. Inc., 401 Proctor Bldg., at $157,057.

N. C., Raleigh—Following contracts let by State Hwy. Comn. for 12 road projects: Chowan-Perquimans Cos. 11.83 mi. hard surf. to Smith Bros. Inc., Dallas, Tex. at $296,635; Columbus Co., 12.89 mi. hard surf. bet. Brunswick Co. line and Bolton to Jas. O. Hayworth, Chicago, Ill., at $265,013; Hartnett Co., 10.74 mi. soil rd. to F. P. Holder, Jefferson, Ga., at $52,800; for roadway, and to T. J. Newell, Clinton, N. C. at $49,646 for bridges; Orange Co. 10.74 mi. grading to Dicuss Bros., Sanford, N. C., at $50,107, and for brdgs. to Richards Bros., Raleigh, at $17,693. Wake Co., 7.81 mi. grading and structs. to C. G. Kershaw Contg. Co., Birmingham, Ala., at $36,788 for roadway, and T. J. Newell at $47,703 for structs.; Randolph Co., 7.97 mi. hard surf. to Allport Constr. Corp., Richmont, Va., at $279,931; Cabarrus Co., 8.59 mi. soil rd. bet. Mecklenburg Co. line and Stanly Co. line to Lee J. Smith, Charlotte, N. C., at $40,557, for roadway and to W. M. Lefler, Wadeville, N. C., at $67,409; Ashe Co. 3.53 mi. hard surf. from Jefferson Orion to Overstreet & Nance, Bedford, Ga., at $108,431; Haywood Co. 11.66 mi. hard surf. to A. J. Wardrep, Knoxville, Tenn., at $372,415; Madison Co., 6.71 mi. shale rd. to Reynolds Constr. Co., White Pine, Tenn., at $103,459 for roadway, and to Moore Concrete Products Co., Andrews, N. C., at $63,784 for structs.

N. D., Fargo—Birch & Sons, Fargo, awarded contract for 40,000 sq. yds. bitulithic paving on College Ave., 9th Ave. N. and 10th St., at $47,671, $53,353 and $37,824, respectively.

O., Euclid—Cleve'and Trinidad Paving Co., The Arcade, Cleveland, awarded contract for grading, curbing and paving 19,310 sq. yds. on 8 streets, asph., at $102,877.

Ore., Astoria—McLean & Williams, Astoria, awarded contract by Clatsop Co. Court for paving one mile market road and 5 miles main Nehalem hwy., at total of $136,603.

Ore., Portland—Guy F. Atkinson, Portland, awarded contract for 24 miles constr. work on Eugene-Florence rd. thru the Siuslaw national forest of Oregon, at $366,835. Proj. will include clearing, grading, crushed rock and gravel surfacing; also bridge constr.

Ore., Salem—Hetrick, Cline & Gardner, Portland, awarded contract by State Hwy. Comn., for impvt. of Otter Rock-Agate Beach section of Roosevelt coast hwy., at $181,000.

Tenn., Dyersburg—Rhodes & E'er, Nashville, awarded contract for impvt. of 7 asphalt streets. Work starts June 1.

Tex., Corsicana—F. P. McElwrath, Corsicana, awarded contract for 7.71 miles 9-ft. conc. pavement on S. H. thru Richland Creek Bottom, at $85,997.

Tex., Liberty—Houston Construction Co., 3102 McKinney Ave., awarded contract to pave 25 miles road at $215,000.

Wash., Olympia—C. W. Payne, Spokane, awarded contract for grading, draining and paving with concrete about 4.85 miles Sunset Hwy.—Spokane Co. line to Reardan in Spokane and Lincoln Cos., at $161,503.

Wash., Olympia—Following contracts let by State Hwy. Cmn.: Inland Empire Hwy., Garfield Co., Pomeroy West, 1.43 miles to Pacific Coast Paving Co., 910 Rust Bldg., Tacoma, Wash., at $8,802; Pacific Hwy., Lewis & Cowlitz Cos., 4.42 miles, Neals to Toledo, at $141,278 to Goetz & Brennan, 917 Seaboard Bldg., Seattle; Inland Empire Hwy., Stevens Co., 6.90 miles at $43,963 to Mitchell Bros., 127 E. Mission Ave., Spokane, Wash.; Sunset Hwy. Douglas Co., 3.07 miles, at $99,475, to Yakima Paving Co., 322 Perkins Bldg., Tacoma, Wash.

W. Va., So. Charleston—(Charleston P. O.) Dave French, Concrete Highway Constr. Co., Catlettsburg, Ky., awarded contr. for paving and sewer constr. (asph. or conc.) at $200,000.

W. Va., Logan—P. Minotti, Logan, awarded contract for paving 3.4 miles of road from Monitor Jct. to Holden, 7-in. conc., at $116,316.

W. Va., Welch—Danville Contg. Co., Danville, awarded contract for grading 7.4 miles rd. from Bradshaw to Grundy, Dandy River Dist., at $65,825; hard surfacing 14½ mi. rd. from Thorp to Jenkinjones and Keanette to Leckie, Adkins Dist. to Valdwin & Jennings, Gary, at $340,000.

SEWERAGE AND SEWAGE TREATMENT

Cal., Long Beach—Griffith Co. L. A. Ry. Bldg. L. A., awarded contract at $105,000 for constr. of Linden Ave. storm drain sewer and extension (rein. conc. pipe 12-in. to 42-in. diam.); Peter P. Janich, 1395 St. Louis St., Long Beach, awarded contract for constr. of 14-in. rein. conc. drainage sewer in Bennett Ave., Ximeno Ave., and alleys (Quincy storm drain extension), at $1,995.

Cal., Los Angeles—Croatian-American Inv. Co., Inc., 208 W. 2nd St., awarded contract for constr. of sewer complete in Burch Pl.—Country Club Dr. to 12th St.,—at $57,700.

Cal., Pasadena—Joe. Chutuk, awarded contract for constr. of segment block sewer at sewage disp. plant at City farm at $43,007.

Cal., Riverside—H. D. Churchill Co., 350 Merrick St., Los Angeles, awarded contract for constr. of san. sewer system, wye branches, manholes, clean-outs, boxes, sludge basins, piling and conc. syphons in various streets, at $117,348.

Cal., Whittier—Harvey Hanawalt, La Verne, awarded contract for constructing lower end outfall sewer and disposal wk., including Imhoff tanks and sludge beds. This omits filter. Contr. price $48,000.

Que., Montreal—Contract for sewer in Patricia and Tiffin Sts. to A. Thezand, 885 St. Catherine St. East, at $11,582 and $1,012 respectively; Decarie Blvd., Fallon and Boyce Sts. to Toussaint Bros., 383 St. I. Denis St. at $2,463; $2,123 and $1,457, respctc.; St. Zotique St. to P. DeSantis, 3929 St. Hubert St., at $4,521; Eadie St. to C. Frascarelli & Co. 654 Berri St., at $18,177.

N. B., St. George—Stephen Constr. Co., Prince William St., St. John, awarded general contract for extension to sewers, at $36,000.

Ind., So. Bend—G. F. Santry Co. 809 S. Leavitt St. Chicago, award. contract for 5,986 ft. 6-12 in. vit. clay sewer, etc. in Clyde, Kinyon, Anderson, Medora, Lafayette and Marietta Sts. Indiana and Parkovash Aves., at $12,456. Engrs'. Est. $14,629; Staples & Ackerman, 424 W. Madison St., 7,789 ft. 6-15 in. vit. clay sewers in Fairview, Calvert and Victoria Sts. and Oak Park Court at $15,327. Engrs'. Est. $18,398; G. McGillicuddy, Valparaiso, 4,995 ft. 6-18 in. vit. clay in Brookfield and William Sts., at $12,241. Engrs'. Est. $12,471.

Ky., Louisville—Cannel-Conrad Constr. Co. Brook St. and Avery Ave. for 34th Street sewer and laterals at $120,334 and $47,203, respectively.

Ky., Paducah—E. R Harding Co., 400 Robinson Bldg., Racine, awarded contract for 14,833 ft. 6-42 inch rein. conc. and vit. clay sewers, at $62,861.

Md., Baltimore—Ryan Constr. Co., 735 Real Est. Tr. Bldg., Phila., awarded contract for storm water constr. 57, at $107,003.

Mass, Boston—Wm. Barrett & Co., awarded contract for sewerage works in Bedford St., at $8,811; C. & R. Constr. Co., awarded contract for sewerage works in Farragut rd. extension and outlet in private land, So. Boston, at $37,935; Jno. Williams & Co., awarded contract for sewerage works in Stowe Rd., at $7,933; R. Zoppo, contract for sewerage works in Dana Ave., at $4,243.

Mass., Boston—V. Barletta, awarded contract for bldg. Dorchester brook sewer in E. Cottage St. and Humphreys St., from Norfolk Ave. to Holden St., Dorchester, at $58,033; M. DeSisto Co., awarded contract for sewerage works in Prospect St., etc., at $5,417; C. Russo, contract for sewerage works

in Ashland St.—Hyde Park Ave. to so. side of Sutton St. W. Roxbury, at $11,075.

Mass., Framingham—R. H. Newell, Uxbridge, awarded contract for 7 mi. 6, 8 and 10-in. sewer pipe in Framingham and 5 mi. Saxonville (Framingham, P. O.) at $115,960.

Neb., Humboldt—Asplund Constr. Co., Tecumseh, awarded contract for sewer system, at $28,551.

Neb., Milford—Arthur Dobson Co., 809 1st National Bank Bldg., Lincoln, awarded contract for san. sewer system at $30,685.

N. J., Glen Rock—(Ridgewood, P. O.)—Sewerage system, 3 sects. to E. B. Edgar, Scotia, N. Y., and 1 sect. to Alberto & Co., 208 Hamburgh Ave., Paterson; sewage disposal plant and pumping sta. to M. Averill, 196 Woodside Ave., Newark—total cost approx. $290,000.

N. J., Matawan—Seaman & Letzkus Co., Stone Harbor, awarded contract for 6.5 miles 6-12 in. sewers, at $84,423; sewage disposal works at $16,998.

N. Y., Buffalo—F. L. Cohen, Inc., Prudential Bldg., awarded contr. for 33 ft. 6-in. by 32 ft. 6-in. rein. conc storm water drain at Scajaquada Creek at $1,379,233.

N. Y. Long Island City—M. E. Connolly, Pres. Queens Boro. Queens Subway Bldg., let contract for sewer in Goodrich St., to Green Contg. Co., 734 Vernon Ave., Brooklyn, at $9,869; 77th, 101st, 78th, 89th and 130th Sts., to E. J. Kelly, Jr., Flushing, at $22,852; to D. Bonnacci, 672 Degraw St. Brooklyn; sewers in Bliss St. $8,194, 95th St., $6,101, 95th Ave., $22,853, 84th St., $29,369; Seaside Contracting Co., 193 Beach 108th St. Rockaway Beach, Kimball Ave., at $9,663; J. Gallo, 203 Division St. Brooklyn, awarded contract for sewer in Mitchell Ave. Lawson, Millard & Norwood Sts., etc., at $63,022.

N. C., Fayetteville—Tucker & Laxton, Realty Bldg., Charlotte, awarded contract for sewerage system, at $150,000.

N. C., Marshville—J. B. McCrary Co. 3rd Natl. Bank Bldg. Atlanta, Ga., awarded contract for sewerage and water works systems here, at $75,000.

Ohio, Akron—Schroeder & Caputo Constr. Co., 1950 W. Federal St., Youngstown, contr. for 8-20 in. vit. sewer, at $6,364; S. Main & Emeling Sts., 30-in. brk., $25,158; S. Arlington St. Dist. Cont. 5, 3-in. and 36 in. brk. pipe, $46,018; S. Arlington St. Dist. Cont. 3, 8-in. 12-in. 15-in. 18-in. 24-in. all vit. pipe, $25,000. H. T. French Constr. Co., 688 Noah Ave. W. Market St. outlet sewer, 30-in. 54-in., 63-in. open cut, $25,450 ft. 63-in. in tunnel; all foregoing brk. pipe—total $135,905.

Ohio, Cleveland—Contr. for 1,430 ft. 24-in. vit. tile sewer in Melba Ave. to. G. Derwish, Cleveland, at $4,498; 320 ft. 3 C and 320 ft. 2 C brk. sewers in Prince Ave. to J. Lahnom, 1133 E. 71st St. at $26,228; 17,613 ft. 18-30 in. vit. clay sewer in Ridge Rd. Impvt. 9, Sec. A, to D. Zullo, 10614 Frank Ave., at $233,272.

Ohio, Cleveland—Salem & George, 3645 E. 140th St. awarded contr. for 6,125 ft. 12-20 in. vit. clay sewers in E. 117th St., E. 143rd, E. 146th and E. 147th Sts., at $43,349.

Garfield Heights—(Cleveland, P. O.)—A. Lanese Co., Columbia Bldg., Cleveland, awarded contract for vit. clay and c. i. sewers and water mains in E. 139th St. Neltrove, Alvin and Rexwood Aves., at $33,349; Saybrook Ave., E. 126th and 139th Sts. to D. Rossi & Marcelleti Co., 13701 Benwood Ave., at $12,205.

Ohio, Youngstown—Contract for Mahoning Co. vit. and concrete sewerage system in Boardman Dist. Sec. 1, awarded to Turner Contg. Co. Park Theater Bldg., at $28,699; Sec. 2 to Turner Constr. Co., 242 Madison Ave., N. Y. City, at $52,108; Sec. 3, to F. George, 657 Mahoning Ave., at $83,151; Sec. 4, to Grubb & Andrews, Youngstown, at $48,210.

Pa., Pottstown—D. H. Whitmer, Hagerstown, Md., awarded contract for laying 53,050 ft. 4-18 in. vit. sewer pipe, 5 tons c. i. pipe, etc., at $86,409.

Tex., Denton—W. M. Jagoe, awarded contract to construct sewage disposal plant, at $40,000.

Tex., Navasota—Smith Bros., Inc., 311 Central State Bank Bldg., Dallas, awarded contract to construct storm sewer; Lock Joint Pipe Co., Dallas, Tex. contract for pipe at $31,540.

Wyo., Laramie—D. S. Reid, Denver, Colo., awarded contract for outfall sewers and sewage disp. plant on basis of alternate outfall and 27-in. lock joint pipe on outfall, at $117,094.

WATER SUPPLY AND PURIFICATION

Cal., Burbank—Claude Fisher, 610 Wright & Callender Bldg., Los Angeles, awarded contract for furnishing and laying 9,000 ft. 6-in. stand. screw wrought iron water pipe on Magnolia Ave. at $1.44 ft. and 2,500 ft. 4-in. same type pipe, at 84c ft.

Cal., Los Angeles—Sidney Smith, 2025 Bay St. awarded contract for constructing water distributing system for Dilling & Lichty in their Florence Ave. Heights Tr. Hyde Park, involving 2,000 ft. 6-in. screw casing at $1.25 ft.; 2,500 ft. 4-in. at 77½c ft.; 5,000 ft. 2½-in. pipe dipped at 42c ft.; 10,000 ft. 2-in. pipe dipped at 42c ft.; also fittings and valves at cost plus 20%; also contract with H. Middleton for furnishing and laying cast iron water mains with cement joints, Belle Meade Tr. involving 5,800 ft. 6-in. Cl B. bell & spigot pipe at $1.50 ft.; valves and fittings to be paid for extra; also contr. with Title Ins. & Trust Co., thru T. C. Shoults Co. for furnishing and constructing pipe lines for water sys. in New West Hollywood Tr., involving 1,000 ft. 4-in. pipe at 77½c; 5,125 ft. 3-in. pipe at 65c ft; 8,000 ft. 2-in. pipe at 40c ft., valves & fittings and labor for installing same at cost plus 20%.

Cal., Los Angeles—Sidney Smith, 2025 Bay St. awarded contracts for following work: Pipe lines Park for Snodgrass & Peters, all 3 tracts are in m Tr. 6115 for H. A. Greene, abt. $2,500; pipe lines for water sys. in Inter-Mountain Invest. Corp. tract, at $4,500; pipe lines in Washington

Cal., San Marino—Sidney Smith, 2025 Bay St. Los Angeles, award. contract by San Gabriel Valley Water Co., for trenching and laying 6,200 ft. cast iron pipe with cement joints at 55c ft.; and 3,500 ft. 4-in. cast iron pipe with cement joints at 35c ft. Pipe is to be laid in the Oak Knoll Dist., of San Marino.

Cal., Santa Ana—U. S. Cast Iron Pipe & Foundry Co., 705 Wright & Callender Bldg., Los Angeles, awarded contract for furnishing city with approx. 1,000 tons cast iron water pipe, at about $60,000.

Ont., No. York Twp.—Contracts awarded by Twp. Council for installation of new water works system are as follows: Dam, pump house, filtr. plant, R. Campbell & Co., at $39,230; pumping machinery, Bauden Machy. Co., at $12,117; filtration equipment, International Filtration Co., at $12,050; elevated steel tank, Morton Steel Co., $16,300; cast iron pipe, National Iron & Pipe Co., $19,000; tank foundations, Rocco & Co., $2,065; laying mains, Rocco Co. and Rusicco & Co., at $4,426.

Ct., Manchester—R. G. Bent Co., 183 Ann St., Hartford, awarded contract by Orford Soap Co., Hilliard St. for rein. conc. reservoir, 200,000 gal. capy., Engr's. estimate $60,000.

La., Plaquemine—City let following contracts for installation of water and light plant: Fairbanks-Morse & Co., New Orleans, at $78,545 for all machinery in power plant; Hayden Constr. Co., Pass Christian, Miss., general contract at $12,000; National Cast Iron Pipe Co., Birmingham, Ala., c. i. pipe; Gray Artesian Well Co., Pensacola, Fla., at $4,000 for artesian well; Columbia Iron Wks., Chattanooga, Tenn., for hydrants and valves.

Minn., Winsted—Phelps-Drake Co., 719 Metropolitan Bldg., Minneapolis, awarded contract for water works system at abt. $30,000.

N. Y., New York—Wataga Contg. Co., awarded contract for hauling and setting valves and hydrants in various streets, at $39,000; mains in Broadway, Amsterdam, 10th and 11th Aves., W. 51st St., 54th, 57th Sts., etc. to Beaver Eng. Co., 57 Chambers St., at $94,410; contract for furnishing, delivering, unloading, stacking and storing cast iron pipe, special and valve box castings, valves and double nozzle fire hydrants, to Kennedy Valve Mfg. Co., 95 John St., at $34,390; Norton Eng. Co., 510 W. 149th St., awarded contract for mains in Webster Ave., Bronx Boro., at $42,000.

Minn., Worthington—J. G. Robertson, 2542 University Ave. St. Paul, awarded contract for 1 water tube boiler and underfeed stoker. 300 h. p., at $23,375.

N. C., Mooresville—City let following contracts for constr. of water system costing approx. $155,000: Quion and Withers, Gastonia, pumpg. sta., filter house, auxiliary station, coagulating basin, storage reservoir, exterior piping, installing pumping equipment and laying pipe lines; Tucker & Laxton, Charlotte, filter equipment; Glamorgan Pipe & Foundry Co., Lynchburg, Va., furnish c. i. pipe; Morris Mach. Wks., centrif. pumps; Chicago Bridge & Iron Wks., Chicago, wash water tanks; Grinnell Co., Charlotte, Columbian valves; City will construct necessary elec. line for pumping purposes.

Ohio, Cleveland—Schirmer O'Hara Co., 2031 Euclid Ave., awarded contract for superstruct. of pumping station, 1 sty., 180x193 ft., 67 ft. high brick, steel and conc., at $516,568.

Ohio, Euclid—A. Harra Co., Ulmer Bldg. Cleveland, O., awarded contr. for mains in Emerson, Prasse, Telhurst and Rainbow Rds., at $16,952; Liberty Rd. to Joseph & Co., 877 Orange Ave. Cleveland, at $10,255; Liberty Rd. to Consolo & Palermo Constr. Co. Benwood Ave., Cleveland, at $12,827. Work includes 9,757 ft. 4, 6 and 8 inch cast iron pipe.

Ohio, Toronto—J. W. McLaughlin, Park Bldg., Pittsburgh, Pa., and Roberts Filter Mfg. Co., 6th & Columbia Sts., Darby, Pa., awarded contract for filtration plant and water works, at $142,100.

Va., Richmond—City let following contracts for constr. of City's filtr. plant: Contr. No. 1 to Whiting-Turner Constr. Co., Stewart Bldg., Baltimore, Md., for filter plant sub-struct., at $337,415; Contr. No. 2, filter plant equipment to Roberts Filter Mfg. Co., Darby, Pa., at $193,650.

Wn., Longview—Long Bell Lumber Co. awarded contr. for san. sewer 45,000 c. y. excav., 29,000 lin. ft. 8-30 in. pipe to Bardsen & Co., Butte, Mont.; storm sewer, 26,000 c. y. excav., 39,000 lin. ft. 10-54 in. pipe to J. D. Hanley, 1316 Rodney St., Portland, Ore. Engineer's est. $150,000.

Wash., Longview—Long Bell Lumber Co. awarder contract for water system for town, involving 56,000 lin. ft. 6-24 in. cast iron mains; 13,000 c. y. excav. to J. Payne, Kelso; Engineer's est. $100,000.

Wis., Wauwatosa—G. E. Zimmerman, 3402 Grand Ave., Milwaukee awarded contract by Met. Sewerage Comn. for main sewer from end of Cont. 1 in State St. to county institutional bldgs., at $247,112.

Prospective Work

ROADS AND STREETS

Ark., Pine Bluff—Plum Bayou Road Impvt. Dist. A. E. Wright, Chmn. contemplates expending $200,000 for constr. of 20 mile gravel rd. in northern part of Jefferson Co. Elbert H. Reynolds, Engr.

Ark., Walnut Ridge—Three Street Impvt. Dists. have engaged engineers to submit plans and ests. of cost of paving streets. Districts Nos. 1 and 2 retained G. S. Buchanan, Morrillton and Dist. No. 3, Wm. B. Hodgens, Walnut Ridge, as engineers.

Fla., Inverness—Citrus Co. Commrs. plan to complete State Rd. 5 together with lat. rds. thru County. $750,000 bonds voted.

Fla., Jacksonville—$2,350,000 bonds voted by Duvall County for bldg. 6 roads; $450,000 for construction of 2 bridges.

Fla., Punta Gorda—State Road Dept.,—H. B. Phillips, Chrmn., Tallahassee—plans to complete section of Punta Gorda-Fort Myers road and appropriated $75,000; Charlotte Co. to receive $50,000.

Fla., Tallahassee—State Rd. Dept.—H. B. Phillips, Chrmn.—Plans improving 6 roads and appropriated funds as follows: Lee Co., St. Rd. 5, $25,000; Charlotte Co. rd., $50,000; surf. S. A. Rd. 107, shell or rock, DeSoto Co., $25,000; Hanatee Co., $25,000; rds. in Glades Co., $40,000; Franklin Co., improve S. A. Rd. 116, $50,000; County to pay $50,000. Also plans expending $1,250,000 to build east coast hwy. thru Flagler and St. Johns Cos.

Ind., Indianapolis—Approx. 19 miles of a 50-mile program of bitum. macadam paving will be constructed this year by St. Hwy. Dept. Mileage will be let in 7 proj. awards. Five counties affected. First bitum. macadam will be laid in Wells, Wayne, Allen, Lawrence and Monroe Cos. Roads are as follows: Rd. 13, Wells Co., extending from brk. pavement in Ossian, south 5.96 miles. Date set for completion, Nov. 15; No. 3, Wayne Co., extending over certain parts from west corp. line of Richmond west to east end of conc road, 1.07 miles. Completion date, Nov. 15; No. 3, Wayne Co. from each corp. line of Richmond, west to Indiana-Ohio State line, 2.97 mi. Completion date, Nov. 15; 14, Allen Co., from so. corp line of Ft. Wayne south 3.47 miles. Comp. date, Nov. 10; No. 44, Allen Co., from west line Ft. Wayne, west 0.80 miles. Comp. date, Nov. 10; No. 22, Lawrence Co., from no. corp. line of Oolitic to Village of Needmore, 2.1 miles; comp. date, Oct. 15; No. 32, Monroe Co., from jct. with State rd. 22 at north corp. line of Bloomington in northwest direction 2.25 miles. Comp. date, Oct. 15. State Hwy. Comn. Jno. D. Williams, director.

Ia. Muscatine—About $125,000 will be expended on paving here during 1923. G. G. Parks, City Clk.

Ky., Calhoun—McLean Co. plans to improve 8 roads, totaling 70 miles; awards contingent upon $350,000 bond issue to be voted on August 4.

Md., Baltimore—Board of Estimates considering plans presented by A. E. Christhilf, Chf. Engr., to cover Gwynn's Run from Baltimore St. to Sequoia Ave. Est. cost $1,000,000. First step to cover stream from Baltimore St. to Penn. R. R. above Lexington St. Approximate cost $100,000.

Mich., Flint—City Council has approved program providing for paving 22 streets and sanitary sewers on 14 streets. Engineer also given authority to proceed with construction of 12 storm sewers. Council has authorized purchase of 2 tractors to be furnished in accord. with specfs. by City Engr.

Mich., Romeo—Citizens have voted to authorize bond issue of $75,000 for paving east and west St. Clair Sts. here.

Minn., St. Paul—City and County officials have decided on following paving for 1923: City Paving: Minnehaha St., $143,000; Lake Phalen Blvd., $120,400; Larpenteur, $6,000; Snelling, $53,400; Connec. thru Como Park, $38,000; River Blvd., $350,000; W. 7th, $90,000; Randolph, $140,000; Sixth, $203,000; Larpenteur, $80,000; Cleveland, $143,000; Robie and Humboldt, $132,000; Sibley Memorial Hwy., $42,000; City Hosp. approach, $21,000; Rondo, $40,000; Oakland Cemetery approach, taoinngs,oSo ant. $108,000; Front, $198,000; Earl, $200,000. County: White Bear Ave., 5.9 miles, $178,000 Edgerton, 1 mi. $30,000; N. St. Paul Rd., 2.5 mi. $75,000; Rice St., $153,000; Co. Rd., 6.7 miles, $102,000; Prescott connect. 4 miles, $180,000; New Brighton rd. 2.5 miles, $75,000; Eustice St. ½ mile, $15,000; Cleveland Ave., ½ mi., $15,000. County's 1924 program is as follows: Centerville Rd.—Edgerton to Centerville and SW exten. to Rice St. rd. 10.8 miles, $326,600; Birch Lake Ave. —Bald Eagle Ave. W. along no. side Birch Lake to Centerville rd. and Bald lake to Centerville rd. and Bald Eagle Ave. from Trunk Hwy. 1 NE to Dellwood, 6.5 miles, $225,000. Geo. J. Ries, Co. Aud.

Mont., Hardin—$105,000 is estimated cost of hard surf. rd. to be built bet. Hardin and Custer (17½ miles). Will get Fed. aid. R. J. Ehpland, Co. Engr.; Carl Rankin, Co. Aud.

Neb., Plainview—Antelope Trail will be surfaced this spring from Plainview to Orchard via Brunswick. Govt. and State aid. S. Greenmayer, Brunswick, interested.

Nev., Carson City—State Hwy. Dept., (Geo. W. Borden, St. Hwy. Engr.) will soon call for bids on 3 important projects in Elko Co., plans now being complete. Projects are Halleck to Deeth; Deeth to Wells and Vivian to W. County line—total about 40 miles.

N. C., Durham—City contemplates paving 7 ad-

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

ditional streets; contemplates $300,000 bond issue; also plans paving N. Queen St.; Dacian St., Duke to Buchanan Blvd.; McMannen St.; Monmouth Ave.; Holloway—Dillard to Mangum, etc.

N. Dak., Bismarck—$1,750,000 will be spent this year in North Dak. on 1½ miles concrete road; 200 miles gravel surf.; 400 miles dirt roads graded and drained. W. G. Black, State Engr.

Okla., Norman—Cleveland Co. Commrs. plan hard surf. rds. connecting with Okla. Co. conc. hwy. on no. and with Asher brdg. and Purcell brdg across Southern Canadian River, via Moore, Norman, Noble and Lexington. $500,000 bonds voted. Plans bldg. bridges on lateral and feed roads to main hwys. in county. $100,000 bonds voted.

Okla., Oklahoma City—State Hwy Dept. will soon receive bids for bldg. 5½ miles road from Okay to point 3 miles from Wagoner thru Shannon Twp.

Okla., Perry—Noble County plans bldg. 6 hard surfaced hwys., totaling 42 miles as follows: 17 miles no. from Perry; 5 miles east and 5 miles west of Perry; 5 mi. east of Billings; 5 miles west of Red Rock and 5 miles west of Morrison. Contemplates voting on $500,000 bonds.

Tenn., Springfield—State Highway Dept., Nashville, plans to build 16-ft. waterbound macadam base rd. from Ridgetop to Springfield; also bridge at no. corp. line of Springfield. Total est. cost is $135,300; one-half to be paid by State and one-half by Robertson Co.

Tex., Galveston—$1,250,000 bonds voted for filling nd grading, western sect. of City; $100,000 bonds voted for improving, paving and draining streets, alleys, avenues and public grounds. Chas. A. Keenan, Mayor.

Tex., Riichmond—Ft. Bend Co.—C. D. Myers, Co. Judge—will soon receive bids for grading, constructing rein. conc. bridges and culverts on 15.1 miles S. H. No. 3; rein. conc. paving on sand cushion; shell shoulders; $605,000; F. A. $230,000. C. H. Kendall, Co. Engr.

Va., Richmond—City considering expending $402,000 to smooth-pave and light Broad St. to Boulevard; $50,000 to extend Monument Ave. to corp limits; $25,000 for street impvts. to Oak Grove and $23,000 to smooth-pave Oakwood Ave. to cemetery. Contemplates $500,000 bond issue.

Wash., Everett—In response to appeal from residents in the dist., Riverside Commercial Club went on record as favoring paving of Pacific Ave.—Chestnut to Wetmore Ave.— about 14 blks. Petitions will be presented to City Commrs. Est. cost of impvt., $75,000.

Wash., Spokane—Forest service and State Officials of Montana and Idaho have determined on impvts. to forest rds. in southern Idaho est. to cost more than half a million dollars. Impvts. include Salmon-Montana line, $200,000; No. Fork Payette, $220,000; Ketchum- Galena, $55,000; Strawberry-Sharon, $15,000; Warren wagon road no. of Payette lake, $30,000; Warm river-Yellowstone, $16,000.

Wash., Walla, Walla—Sufficient money has been set aside to complete 30 miles Lolo Pass Hwy. bet. Missoula and Lewiston. Appropriation approved is $482,000. Approval given by officials of Fed. Bureau of Pub. Rds., Forest Service and Ida. State Rd. officials.

W. Va., Clarksburg—Harrison Co. Eagle Dist., plans to construct 8 roads. $549,665 bonds voted.

SEWERAGE AND SEWAGE TREATMENT

Ark., Dequeen—Soon as bonds sold are approved by attys., for M. W. Wilkins & Co., Little Rock, contracts will be let for extension of sewers and water mains to all parts of the city; also establishment of pumping plant. City will have own artesian wells. Impvts. will cost about $100,000. W. L. Winters, Fort Smith, Engr.

Ark., Ft. Smith—Constr. of about $40,000 worth of sewers in original storm and san. sewer dist. No. 2, being considered. Fagan Bourland, Mayor.

Ark., Little Rock—Petition filed with County Ct. for formation of sewer impvt. dist. to provide all of Park Hill and Crest View addns., total of approx. 400 acres, the largest sewer dist. formed in or around Little Rock. Commrs. are: W. B. Sanders, L. A. Riley and C. T. Ryan.

Cal., Huntington Park—$250,000 sewer bonds voted here at recent election. Issue provides for new sewer system, outfall and disposal and treatment plant. Howard McCurdy, Pacific Elec. Bldg., Los Angeles, City Engr. Work involves comb. outfall and interceptor sys. approx. 4 miles in length, 10 acres land for treatment plant, activated sludge system, settling tanks and filters. Outfall will cost approx. $55,000. Pipe will vary from 18 in. to 24 in. Kind of pipe has not yet been determined.

Cal., Los Angeles—W. T. Knowlton, Engr. of Sewers, Los Angeles, announced that plans and specfs. for most of the sections of new outfall sewer will be submitted to Board of Pub. Wks. soon. Total length of outfall is 15.4 miles of which 7.2 miles will be semi-elliptical design. 12 ft. high and 13 ft. wide; 2 miles to be laid in open cut and remainder in tunnel. Remaining portion will be circ., 4 ft. 9 in. to 8 ft. 6 in. diam. Av., length of each sec. abt. 1.4 miles. Bids will be taken for 3 types circ. sewer—brk. arch on conc., invert., segmental blk. on conc. base and precast rein. conc. pipe with vit. tile lining on conc. base. Bids for elliptical sewer will embrace 2 types: brk. arch on conc. base with vit. brk. inner ring and segmental blk. for upper quadrant and liner for remainder of interior surf. above conc. base. Depth of sewer for Secs. 10 and 14 incl. will average 18.3 ft. Ocean end of outfall will consist of 5145 ft. 84-in. precast reinf. conc. pipe with 2 60-in. branches each 283 ft. at outlet; pipe to be laid just below ocean flr. and protected by bulk concrete.

Cal., Pasadena—City Directors have started proceedings for constr. of sewers in N. W. portion of city. W. C. Earle, City Engr. estimates 86,000 lin. ft. or 16.3 miles sewer pipe, ranging in size from 8-16 ins., will be laid; also 3,322 Y branches, 299 manholes and 70 flush tanks will be required. Est. cost $112,000. In order to safeguard water supply 1,218 ft. sewer pipe, passing over water tunnels nr. Devil's Gate dam, will be laid in concrete. Linda Vista sys. will call for laying 4.7 mi. pipe. Est. cost $56,000. Pipe ranging 8-20 ins. diam. Ests. on cost of Brookside outfall not completed.

Cal., San Pablo—San Pablo San. Dist. had plans prepared for sewers in portions of Gertrude St., 11,000 lin. ft. 6-in. vit. pipe, etc. R. L. Calfee, 221 S. 22nd St. Richmond, Cons. Engr.

Cal., Whittier—Permission granted to city by St. Bd. of Health to construct outfall sewer and high grade treat. plant at Whittier sewage farm. Est. cost $150,000.

Ont., Kitchener—Plans being prepared for activated sludge plant with gravity system, booster pump and station. Est. cost $85,000. S. Shupe, City Engr. Prices desired on materials.

Ont., Toronto—City considering laying 20,000 ft. 8-in. vit. sewer in Belsize Dist. Est. cost $69,500. Plans also being prepared for san. sewers in Ave. Rd., Oriole Parkway, Burnaby and Willowbank Blvds. $21,075; Brookdale Ave., $5,250. R. C. Harris, City Engr.

Conn., Middletown—Public Works Dept., plans 10,000 ft. 8-in. sewer vit. clay and tile. $40,000. J. W. Hylchrest, 255 Main St., Director.

Fla., Miami Beach—City will extend sewer system; install 8-in. 15-in. 18-in., 27-in. piping. H. W. Davidson, City Engr. Lately voted $200,000 bonds.

Fla., St. Petersburg—E. C. Garvin, Director of Pub. Wks., will expend approx. $230,000 for new sewer system; 130,900 ft. 6-in. to 21-in. vit. pipe or cement conc.; will install low head, direct connected to 3-phase, 60-cycle, 220 volt or D. C. motors, centrif. pumps and automatic control equipment for sewage pumping. H. T. Davis, Director of Finance.

Ill., Phoenix—(Thornton, P. O.) Plans construction of sewerage system here. Est. cost $200,000. A. W. Hersey, City Hall, Harvey, Engr.

Ill., Taylorville—Constr. of intercepting sewers and sewage disposal plant being considered. Est. cost $150,000. Kelker, De Leuw & Co., Conway Bldg., Chicago, Ill., Cons.Engrs.

Kans., Herrington—Plans under way for sewer impvts. $250,000. Black & Veatch, 701 Mutual Bldg. Kans. City, Mo., Cons. Engrs.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

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Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

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Madison Foundry.

Packing.
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Republic Creosoting Co.

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Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

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Cummer & Son Co., The F. D.
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Paving Plants (Asphalt).
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East Iron & Machine Co., The
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Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Mich., Monroe—Contract will be let some time this summer for cleaning out and widening of Plum Crk. so. of Monroe. Est. cost bet. $40,000 and $50,000. Creek will be 20 ft. wide at bottom from Lake Erie to trks. of Pere Marquette railroad and 15 ft. from that point to county farm. Depth will vary from 4-9 ft. 35 drains will be built in Monroe Co. this summer; largest being Plum Crk. which is 14 miles long.

Mich., Pontiac—Two extensive sewer jobs set in motion here; one to provide sanitary sewers for all that portion of Ferry Farm subdiv. not now so provided; the other to provide san. sewers for homes on streets surrounding Dawson mill pond where it is necessary to remove all contamination from Clinton river.

Mo., Edina—City has retained F. H. Frauens, Jr., of the W. B. Rollins Co., Engrs., Kansas City, Mo., to prepare prelim. plans and estimates for sewerage system; also probable impvts. to water works.

Mo., Gallatin—$35,000 bonds voted for completion of trunk line sewer.

N. Y., Corning—Election may be held to vote on $30,000 bonds for new sewers and water main extensions. W. C. Drake, City Engr.

Ohio, Columbus—City plans 28,593 ft. 6-24 in. vit. sewer extending from Wilson to Ohio Aves., at cost of $50,478; 5,357 ft. 8-10 in. cast iron sewer in Campbell St. at cost of $8,124. R. H. Simpson, City Hall, Engr.

Ohio, Wadsworth—Surveys being made to determine whether to junk present sewerage and water works plant, or construe new plants. Est. cost $100,000. R. E. Garvin, Davis & Farley Bldg., Cleveland, Engr.

Okla., Ft. Gibson—$45,000 bonds voted here for sewerage system and disposal plant; 35,000 ft. 6-12 in. vit. clay pipe. Gant & Baker, 1st National Bank Bldg., Okla. City, Engrs.

S. D., Alcester—Plans being made for san. sewer system, disposal plant, etc. T. H. Johnson, 319 Iowa Bldg. Sioux City, A. A. Treick, City Aud.

W. Va., Bluefield—City will vote on $800,000 bonds for sewer constr. impvt. of streets, develop. of parks, etc.

W. Va., Morgantown—City Council will appropriate $100,000 for sewer impvts. along various streets.

W. Va., So. Charleston—(Branch of Charleston) City voted $170,000 bonds for sewers and paving.

Wis., Phillips—$40,000 bonds voted here for sewer and water system; pumpg. sta., reservoir and mains. Carl F. Scheel, City Clk.

Tex., Whitesboro—$50,000 bonds voted for sewer system.

WATER SUPPLY AND PURIFICATION

Ala., Albany—Ala. Water Co., has applied to Pub. Service Comn. for permission to issue $105,000 bonds for impvts. to plants in Girard, Greensboro, Bessemer, Anniston and Decatur. Plans include installation of additional pumping unit and laying new water mains in Bessemer; installation of filter plant at Girard; water meters in Anniston and Decatur; also impvts., to company's water supply sys. at Greensboro.

Ala., Alexander City—City having plans prepared for constr. of water works system. Est. cost $100,000.

Ark., Van Buren—City planning impvts. to present pumping station on Lees Creek. Impvts. consist of intake 700 ft. above pumping sta., installation of 2 sets motor-driven pumps with duplicate units, 500-gal. capy. per min. each; 2 filter units each, having capy. of 500,000 gals. per day; conc. reservoir 40 ft. diam. and 20 ft. deep; extend distribution sys., install 97 fire hydrants. W. L. Winters, Civil Engr. Ft. Smith, in charge.

Cal., Alhambra—City Comn., has decided to submit to city voters bond proposition amounting to $349,000, comprising following items: $250,000 for water dept., extensions and betterments; $75,000 for fire dept.; $12,000 for storm protection and $12,000 for city yards. Resolution to call election adopted.

Cal., Loveland—City is to have new water system est. to cost $350,000. New settling basin will be erected in the mountains 8 miles from city; water to be piped in 24-in. mains.

Cal., San Bruno—City will vote on issuance of $200,000 bonds for purpose of improving and extending water work sys.

Ont., Birchcliff—Pub. Utilities Comn., Scarboro Twp., contemplates laying 16,000 ft. 6-12 in. cast iron mains in Regent Park Subdiv. Est. cost $58,000. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs.

Ont., Cochrane—City will build filtration and chlorination plant. Est. cost $25,000 to $50,000. Works system being obtained. May cost about $75,000.

Ont., Durham—Plans and estimates for water works system being obtained. May cost about $75,000.

Que., Montreal—Greenfield Park voters recently passed by-law expressing themselves in favor of borrowing $70,000 for installing water mains and sewers on main sts. This is prelim. action to installing water and sewers throughout town.

Ont., So. Porcupine—Tisdale Twp. having plans prepared for constr. of pumping plant and distribution system. Est. cost $250,000. H. F. Henderson, Timmiins, Engr.

Que., Three Rivers—Plans prepared and by-laws for following water works will be submitted to ratepayers in near future: Aqueduct and sewer Boulevard St. Louis, $5,720; aqueduct, Des Forges St., $3,910; aqueduct and sewer, Notre Dame and Gilmore Sts., $3,190; extension to services in aqueduct and sewer, $7,820; new water intake at pumping sta., $5,192. Filtration plant, costing $250,000, is also being considered by Council.

Conn., Hartford—Colts Patent Fire Arms Co., Huyshope, Ala., plans to construct 40x60 ft. conc. reservoir; 7 ft. deep; 100,000 gal. capy. Est. cost $60,000. Private plans.

Fla., Fulford—Harvey B. Graves, Trustee for Sunny Isles Water Co. will construct water pipe line from Fulford to the Atlantic Ocean.

Mo., King City—Plans being made for new water system; $70,000 bonds voted. A. T. Archer & Co., 609 New England Bldg., Engrs.

N. Y., Fairport—Board of Village Trustees had plans prepared for reservoir and gravity system water supply. Est. cost $225,000. J. P. Wells, 249 Cutler Bldg., Rochester, Civil Engr.

N. Y., Syracuse—Director of Div., State Dept. of Health, recommends installation of new chlorinator.

N. C., Chapel Hill—University of North Carolina has appropriated $120,000 for permanent water supply system. T. A. Atwood Corp., Chapel Hill, Engrs.

N. D., Bismarck—Will take bids this spring for water plant. T. R. Atkinson, City Engr., has prepared plans. Cons. Engr. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul. Work includes water works, filtration and softening plants. Est. cost $700,000. Will vote on bond issue of $225,000 soon; remainder to be taxed.

N. D., Fargo—Union Light, Heat & Power Co. has petitioned City Council for right to run double water main from Red river above dam to plant; also contemplate installing condenser type turbine engine unit. Est. cost $300,000. M. L. Hibbard, Gen. Mgr.

Ohio, Bedford—Will advertise for bids this summer for cast iron water mains in various streets. E. P. Wright, Twn. Hall, Engr. Est. cost $150,000.

Ohio, Cleveland—Cuyahoga Co., will take bids this summer for 4.2 mi. v. i. mains in Ridge Rd. —Bean to Pleasant Valley Rd. and York Rd.— —Parma Heights Vil. limits to Sprague Rd. etc. Est cost $140,000. R. F. MacDowell, Engr., Court House.

Ohio, Columbus—City considering laying 28,595 ft. 4-8 in. c. i. mains in Mock Rd., Wilson Pl. Sunset and Westwood Drives, Gates and Mithoff Sts., Kirby, Wilson, Thruman, Linwood, Studer, Eureka, Ray, 4th, Cordell, 14th, Thurlow, Stevens, Manhattan, Jefferson, Neil, Leona and 26th Aves. Est. cost $57,190. R. H. Simpson, City Engr. Plans being prepared for 13,025 ft. cast iron mains in various streets at $26,340.

Wash., Camas—Plans and specfs. will be completed in about 30 days for constr. work on water works which will consist of laying abt. 8 miles pipe from city to headquarters of Little Washougal river; a small diversion dam and intake; small additional city reservoir and improvements to distribution system. Total est. cost of impvts. $100,000. Stevens & Koon, Cons. Engrs. Spalding Bldg., Portland, Ore.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Evinrude Motor Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surface Heaters
Chausse Oil Burner Co.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Tool Heaters, Asphalt
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Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
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